

## *User Guide*

# Thermolator<sup>®</sup> vacuTrac

**Positive/Negative Pressure  
Water Temperature Controller  
with TW-1 or TW2 Microprocessor**

*Installation*

*Operation*

*Maintenance*

*Troubleshooting*



*Instant Access  
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The Conair Group, Inc.  
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Pittsburgh, PA 15202  
Phone: (412) 312-6000  
Fax: (412) 312-6227

## TEMPERATURE CONTROL UNITS

### Thermolator® vacuTrac (VTR1-DI and VTR2-DI) Positive/Negative Pressure



## CONTROL TEMPERATURE AND STOP MOLD LEAKS

Keep your operation up and running with the Thermolator vacuTrac water temperature controller. This positive/negative pressure unit can be used as a temporary fix for a leaky mold or bad O-rings.

The vacuTrac is equipped with a manual three-way ball valve that allows you to change the unit from positive pressure to negative pressure by moving the valve handle on the back of the unit counterclockwise. Changing the unit to operate with negative pressure allows the unit to draw air into the mold effectively stopping leaks.

### *Single or dual zone models available*

Use the vacuTrac to produce negative pressure in the from process lines. Otherwise, the unit functions like a direct injection temperature control unit and can be used when your application requires process temperatures up to 180° F.

The unit is equipped with a high-capacity, heavy-duty jet pump/venturi. Choose 9 or 12 kW heaters and pumps from 2 to 7.5 Hp.

Specify single zone if you need one temperature throughout your mold, or dual zone if two different setpoints are required.

You have a choice of two advanced microprocessor control systems. Other options include bell, strobe or piezo horn for alarm conditions.

#### ■ INCOLOY HEATERS

Standard on the vacuTrac, Incoloy heaters resist damage from high temperatures and chemicals.

#### ■ THREE-WAY BALL VALVE

Quick and easy changeover from standard positive pressure to negative pressure operation.

#### ■ LIFT-OFF ACCESS PANELS

Convenient, tool-free access to internal components. The cabinet lifts away for easy maintenance and servicing.

#### ■ STATE-OF-THE-ART CONTROLS

Easy to use microprocessor controls provide accurate temperature control. Auto-tuning of the PID control parameter provides uniform temperature control regardless of light or heavy external loading.

#### ■ COMPACT, STURDY DESIGN

Small footprint. Designed for efficient use of your valuable floor space.

## FEATURES

## TEMPERATURE CONTROL UNITS

### Thermolator<sup>®</sup> vacuTrac (VTR1-DI and VTR2-D2) Positive/Negative Temperature Controller

#### FEATURES

**Expansion/fluid reservoir**  
accepts thermal expansion  
of fluid when heated.

**Level switches**  
control tank fluid level.

**Air/water separation  
tank** allows entrapped  
air to escape to the  
expansion tank.

**High efficiency pump**  
pushes fluid through  
the system.

**Overflow connection**  
relieves system static  
pressure.

**Venting line** prevents  
trapped air in system.

**Pressure relief valve**  
prevents system  
over pressurization.

**To process  
pressure gauge**

**Three-way ball valve**  
diverts flow to  
generate vacuum.

**From process  
pressure gauge**

**Vacuum generating jet  
pump/venturi**

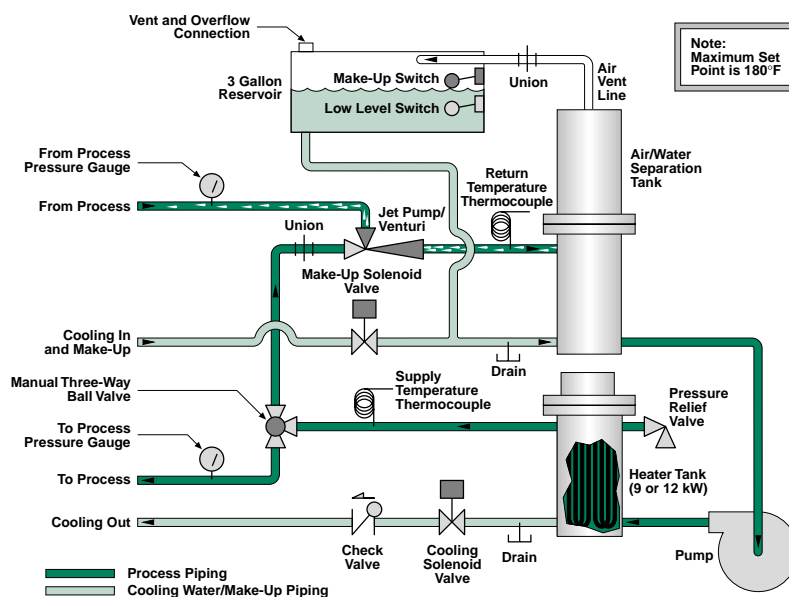
**Cooling water outlet**

**Cooling check valve**  
prevents coolant back  
flow into the vacuTrac.

**Cooling water inlet**

**Cooling solenoid valve**  
lets hot fluid out of system.

**Make-up solenoid valve**  
maintains tank level.



Positive/negative pressure units use a jet pump/venturi to produce negative pressure in the "from process" lines.

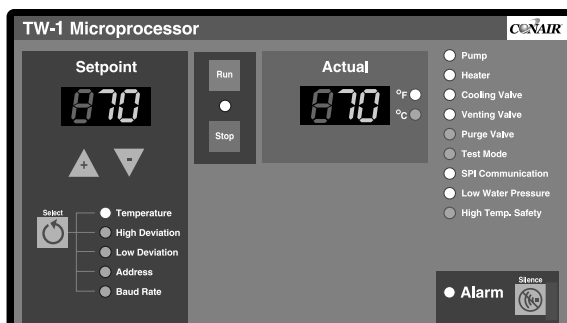
Water at positive pressure will leak out of mold cracks or bad o-rings. During negative pressure operation, however, air is drawn through the lines, and the mold operates without leaking. A manual three-way ball valve can be closed to make these units into standard direct injection units. Because the units use water and vent to the atmosphere, they have a maximum process temperature of 180° F.

## FEATURES

## TEMPERATURE CONTROL UNITS

### Thermolator® vacuTrac (VTR1-DI and VTR2-D2) Positive/Negative Pressure

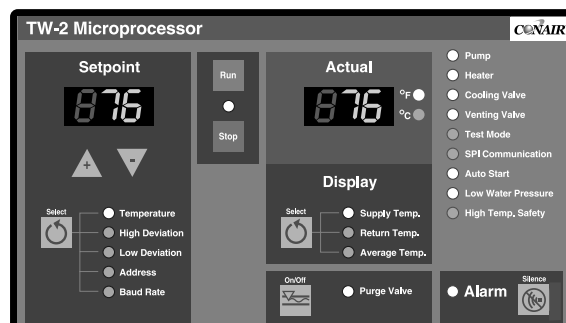
#### CONTROLS



#### vacuTrac Control (TW-1)

Our waterproof, durable control is operator friendly and smart. Standard features:

- **Automatic fine-tuning of PID control** parameters provides uniform temperature control regardless of external loading.
- **Adjustable high/low deviation warnings** track with your setpoint temperature. Pre-programmed acceleration feature speeds up setting parameters.
- **18 operating and fault indicator lights**, including 7 bi-color LEDs, tell you the status of critical components and parameters.
- **Password entry** prevents unauthorized or accidental changes to operating parameters.
- **RS485 communication** using SPI protocol. Baud rates and addresses are programmable on the operator panel.



#### vacuTrac Plus Control (TW-2)

Includes all of the features of the standard vacuTrac control, PLUS:

- **Autostart capability** for convenient pre-heating of molds. Works with external timers or switches.
- **Choice of temperature control points** allows you to monitor and control from the process supply or process return temperature, or from an average of the two.
- **Phase detection circuit** indicates incorrect pump rotation or an open electrical leg.
- **Remote control** up to 50 feet. Magnetic panel back allows you to place the controls where you need them. Comes with 15-foot cable. Lengths of 30 or 50 feet optional. Note: The purge option is not available on the vacuTrac positive/negative pressure water temperature controllers.

#### OPTIONS



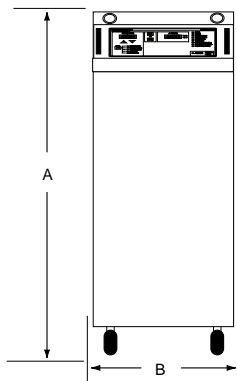
#### Alarm packages

Call attention to alarm conditions with a light and horn package.

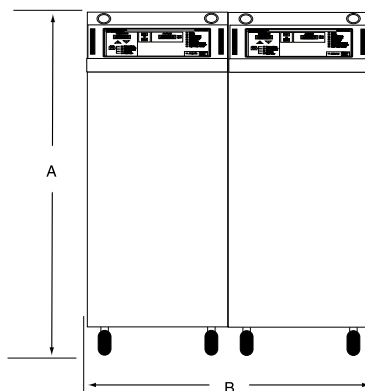
# SPECIFICATIONS

## TEMPERATURE CONTROL UNITS

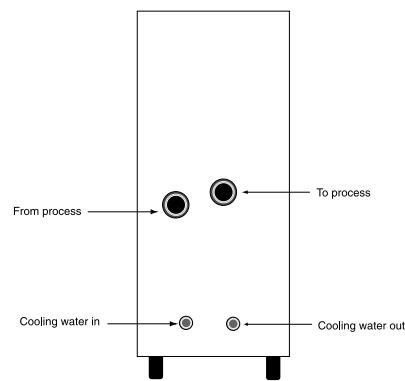
### Thermolator® vacuTrac (VTR1-DI and VTR2-DI) Positive/Negative Pressure



VTR1-DI (single zone)



VTR2-DI (dual zone)



VTR1-DI rear view and connections

MODELS	VTR1-DI				VTR2-DI			
Performance Characteristics								
Minimum setpoint	32 °F {0 °C}				32 °F {0 °C}			
Maximum setpoint	180 °F {82 °C}				180 °F {82 °C}			
Pump Performance per zone								
Pump Size Hp {kW}	2 {1.49}	3 {2.24}	5 {3.73}	7.5 {5.59}	2 {1.49}	3 {2.24}	5 {3.73}	7.5 {5.59}
Nominal flow gpm {l/min}	55 {208}	80 {303}	100 {379}	115 {435}	55 {208}	80 {303}	100 {379}	115 {435}
Pressure @ nominal flow psi {bar}	31 {2.2}	35 {2.5}	43 {3}	51 {3.6}	31 {2.2}	35 {2.5}	43 {3}	51 {3.6}
Dimensions inches {mm}								
A -Height	43 {1090}				43 {1090}			
B- Width	14 {355}				28 {710}			
C- Depth	31.5 {800}				31.5 {800}			
Weight lb {kg}								
Operating	300 {136}	305 {138}	310 {141}	320 {145}	600 {272}	610 {277}	620 {281}	640 {290}
Shipping	470 {213}	475 {216}	480 {218}	490 {222}	770 {349}	780 {354}	790 {358}	810 {367}
Water Connections NPT inches (Female)								
To/From Process	1.25				1.25			
Cooling Water Inlet/Outlet	0.75				0.75			

ELECTRICAL REQUIREMENTS - full load amps †												
Heater Voltage	VTR1-DI								VTR2-DI			
	9 kW				12 kW				9 kW			
	208V	230V	460V	575V	208V	230V	460V	575V	208V	230V	460V	575V
<b>Pump sizes</b>												
2 Hp {1.49 kW}	31.8	28.8	14.4	11.5	40.2	36.4	18.2	14.6	63.6	57.6	28.8	23.0
3 Hp {2.24 kW}	34.7	31.4	15.7	12.6	43.1	39.0	19.5	15.6	69.3	62.8	31.4	25.1
5 Hp {3.73 kW}	38.5	34.8	17.4	13.9	46.8	42.4	21.2	17.0	76.9	69.9	34.8	27.8
7.5 Hp {5.59 kW}	45.7	41.4	20.7	16.6	54.1	49.0	24.5	19.6	91.5	82.8	41.4	33.1

#### SPECIFICATIONS NOTES:

†All voltages are 3 phase, 60 Hz.

Specifications can change without notice. Check with a Conair representative for the most current information.

## CONAIR THERMOLATOR VTR POSITIVE/NEGATIVE OPERATION

### 1.0 PROCESS WATER CONNECTIONS

#### PROCESS CONNECTIONS

Connect the **FROM PROCESS** and **TO PROCESS** connections on the back of the Thermolator using 1-1/4" NPT piping. Viewed from the rear, the **FROM PROCESS** connection is located on the left hand side of the unit, and is clearly marked "**FROM PROCESS**". The **TO PROCESS** connection is located on the right hand side of the unit, and is marked "**TO PROCESS**" in close proximity on the back panel.

#### OVERFLOW/VENT CONNECTION

Connect the **OVERFLOW/VENT** piping on the reservoir tank, located at the top rear of the unit, to an open drain or vented, covered container. This connection must be piped with a clean break in order to prevent back flow and pressure in the **PROCESS** piping. This is where a VTR vents air out of the **PROCESS** piping since the unit is operating at times in a vacuum mode, and can be introducing small amounts of air into the **PROCESS** piping.

*Note: Always use a back-up wrench to support the piping when making connections to the unit.*

### 1.1 COOLING/MAKE-UP WATER CONNECTIONS

#### COOLING CONNECTIONS

Connect the **COOLING WATER IN/MAKE-UP** and **COOLING WATER OUT** piping to the Thermolator using 3/4" NPT pipe. Viewed from the rear, the **COOLING IN/MAKE-UP** hookup is in the lower left hand side through the back panel and is marked "**COOLING WATER IN**". The **COOLING WATER OUT** hookup is in the lower right hand side through the back panel and is marked "**COOLING WATER OUT**".

*Note: The cooling water out connection is piped with a swing check that must not be turned on to its side when the connection is made.*

### 1.2 COOLING/MAKE-UP WATER PRESSURES

#### COOLING /MAKE-UP SUPPLY & RETURN WATER PRESSURES

Cooling /make-up **SUPPLY** and **RETURN** water pressure must have net pressures of between 25 PSI and 75 PSI. A net pressure less than 25 PSI may not provide sufficient cooling for the process. The net pressure is the difference between the cooling **SUPPLY** and **RETURN** pressures.

### 1.3 SEQUENCE OF OPERATION

#### SEQUENCE OF OPERATION

VTR1 units control process water temperature. When the controller signals the unit to heat, the electric immersion heater is energized raising the **PROCESS** water temperature. When the controller signals the unit to cool, the **COOLING WATER OUT** (1/4") solenoid valve is energized. This allows the hot **PROCESS** water out of the process piping. When sufficient water has been pumped out of the unit, the **MAKE-UP**

water level float switch will make, opening the *COOLING/MAKE-UP* (3/8") solenoid valve, replacing the hot discharged water with cooler water.

This unit's operation is similar to a TW-DI unit except that a VTR unit has a reservoir tank that is open to the atmosphere, which allows a maximum 180° F *PROCESS* water temperature.

- Notes:**
- 1. The DIN units do not have pressure switches. They use float switches instead*
  - 2. The make up water level float switch is the higher one in the reservoir tank. The low water level cut-out float switch is the lower one in the reservoir tank.*
  - 3. Anytime the three phase power is turned on to the unit the cooling/make-up water is (3/8") solenoid valve may energize.*

The VTR unit operates in either a positive or negative pressure mode. Upon energizing the unit, if the make-up level float switch is in the made position, the *COOLING/MAKE-UP* water in (3/8") solenoid valve will open and begin to fill the unit's *PROCESS* piping and reservoir tank. As the water level rises in the reservoir tank, or if it is sufficiently full to begin with, the low water level float switch will make, turning off the (*LOW WATER PRESSURE*) light on the operator panel.

#### **STARTING UP THE UNIT**

The start button may now be pressed to energize the unit. The negative pressure mode of operation is initiated by turning the 3-way valve (See Figure 1.) at the back of the unit counter clock-wise. Negative pressure in the process piping is caused by diverting some of the flow from the pump through the eductor. The water bypassed to the eductor creates a high velocity flow at the eductor nozzle which then causes a suction on the from process line.

Never turn the valve all the way to "negative" (counter clockwise), because all the flow will bypass the process, and there will be no temperature control of the mold. When the unit is running in a negative pressure mode, any leak that was in the system will now be drawing air in to the process piping.

The air and water mixture is separated in the separation tank located on the suction side of the pump. The air is vented from the unit through the overflow connection on the back of the reservoir tank. If this vent becomes plugged, the unit will not work properly.

#### **1.4 TROUBLESHOOTING A VTR UNIT**

A few things may cause the VTR unit to act erratically. If glycol is present in a heavy concentration within the process water, it may foam and back up into the reservoir tank. This can cause the reservoir tank to overflow, or the float switches to stick. This problem may be eliminated by using an anti-foaming agent in the water, and periodically opening the (1") pipe plugs on top of the tank to clean the switches with a soft haired paint brush.

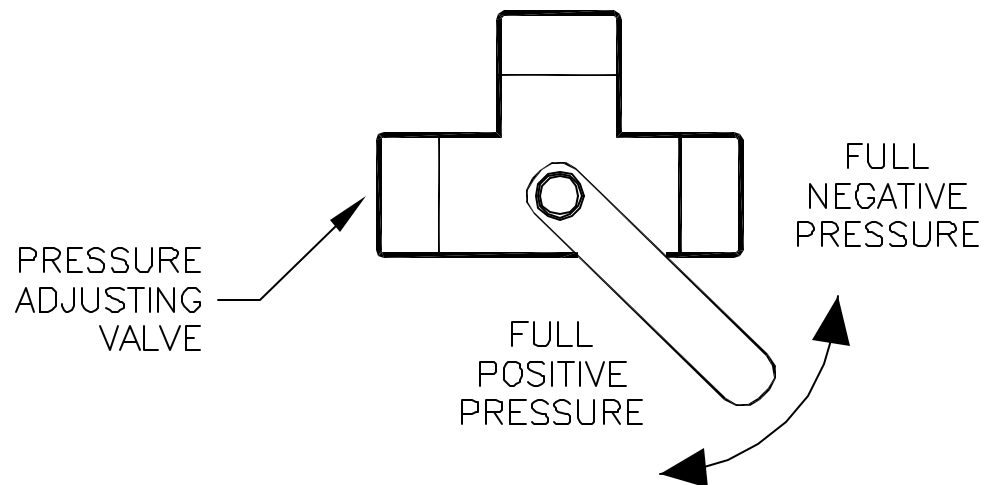
An inability to get desired cooling can be a problem with a VTR unit. If the cooling water out line pressure is greater than the unit's pump discharge pressure, there is no way for the unit to cool. A change in the installation will be required in order to provide a reduced cooling water out line pressure.

If the reservoir tank continuously overflows there is a chance that either a float switch has stuck or the cooling/make-up valve has stuck open from a piece of dirt.

Figure 1.

### LEAK STOPPER VALVE ADJUSTMENT

1. RUN UNIT ON FULL POSITIVE PRESSURE UNLESS PROCESS REQUIRES LEAK STOPPING
2. MOVE VALVE HANDLE FROM FULL POSITIVE PRESSURE COUNTER-CLOCKWISE UNTIL LEAK JUST STOPS
3. TOO MUCH NEGATIVE PRESSURE WILL CAUSE EXCESS AIR INTAKE AND REDUCED COOLANT FLOW TO THE PROCESS










## THE TW-1 CONTROL

## OPERATION

### Starting the Thermolator®.

- 1 Turn on main power to the Thermolator®.**
  - ◆ Setpoint and actual windows display **888** for three seconds, then display the most recently entered setpoint temperature and the current actual temperature.
  - ◆ Indicator lights blink green, then red.
- 2 Turn on water supply to the unit.**  
If the water supply is on, go to Step 3.
- 3 Enter the temperature setpoint.**  
Press the Setpoint  until the green light appears next to Temperature. Press  to increase the setpoint or  to decrease.
- 4 Press .**
  - ◆ The RUN/STOP light turns green.
  - ◆ The unit initiates a 60-second venting sequence. Cooling and venting valves are active for 60 seconds. The pump is active for the final 30 seconds.
  - ◆ Normal operation begins. The heater turns on if the actual temperature is below setpoint. The cooling valve remains active if the actual temperature is above setpoint.

If the **Alarm light turns on**, press  to silence an audible alarm and go to the Troubleshooting section.

### Stopping the Thermolator®.




- 1 Press .**
  - ◆ The RUN/STOP light turns red.

#### Setpoint display

The window displays the setpoints entered for the fluid temperature, the high and low temperature deviation alarms, the SPI baud rate and the SPI address.

#### Run/Stop

Press the RUN button to start normal operation. Press STOP to stop the temperature control unit.




-  = Running
-  = Stopped
-  = Alarm (flashing)

#### Actual values display



The green window displays the temperature at the middle of the mold. This temperature is calculated as an average of the temperatures of the supply water and return water. The lights indicate whether the temperature is in degrees Fahrenheit or Celsius.

#### Status lights

The lights indicate the operating status of the listed components. Except in Test Mode and Auto Start, the lights indicate:

-  = Off or inactive
-  = On or active
-  = Alarm condition

**Test Mode** is used for initial programming. When test mode is enabled, normal operation is disabled.

-  = Test Mode off
-  = Test Mode on; unit dis-

#### Alarm





Press to acknowledge the alarm light and silence the optional audible alarm. The alarm light will flash until the cause of the alarm condition is fixed.

#### Setpoint Select button

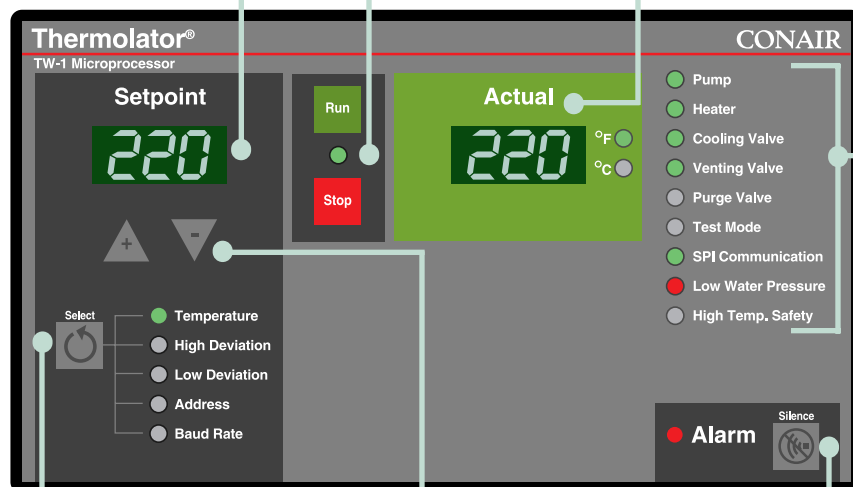
Press repeatedly until a green light appears next to the parameter you want to program or view.

**NOTE:** Default settings for the deviation setpoints are:  
High = setpoint + 10° F  
Low = setpoint - 10° F  
A warning alarm occurs (indicator light turns red) whenever the actual temperature is outside this setpoint range. Recommend setting:  $\pm 2-10^\circ$ .

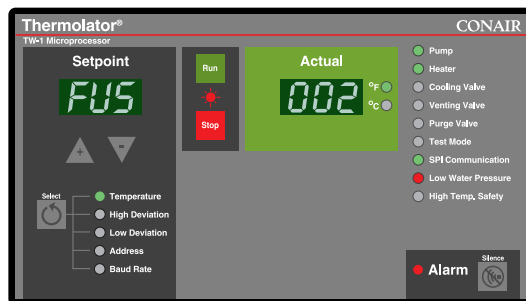
#### Setpoint adjustment buttons

Press  or  to enter temperature and SPI parameters. Press  to increase a value. Press  to decrease a value.

**TIP:** Press and hold the button for faster scrolling speed.



## TROUBLESHOOTING



If there is a problem, the Thermolator® activates the red Alarm light and changes the RUN/STOP light from green to flashing red.

**1** Press to silence the optional audible alarm.

**2** Check the indicator lights and messages to help determine the cause of the problem.

Pump

**WARNING:** Before servicing the Thermolator® Allow the unit to cool to below 100° F. Disconnect and lockout the main power source. Disconnect water and air supply lines.

## Shut down alarms

The Thermolator has shut down automatically to prevent damage to equipment or personnel. To resume normal operation, press **Stop**, fix the problem, then press **Run**.

Pump

**The pump overload has tripped. Contact is open.**

1. Verify that the correct voltage is supplied to the motor.
2. Water flow may be more than the pump can handle. Check current draw against motor rating. Decrease flow as needed.

Low Water Pressure

**The supply water level is low.**

1. Verify that the water supply is turned on.

**NOTE:** The low water pressure alarm does not require manual reset. It will reset automatically when the water level is sufficient.

High Temp. Safety

**The actual temperature of water supplied to the mold exceeds the 190° F temperature safety switch limit.**

1. The unit is not running. Start the Thermolator.
2. Water has stopped flowing between supply outlet and return inlet. Check for closed valve or plugged line.
3. The heater contactor failed. Replace contactor.

Hi

SAF

**Actual temperature of water supplied to the mold is higher than the programmed 190° F safety limit.**

1. Water has stopped flowing between supply outlet and return inlet. Check for closed valve or plugged line.
2. The heater contactor failed. Replace contactor.

Lo

SAF

**Actual temperature of water supplied to the mold is below the programmed 20° F safety limit.**

1. The cooling valve is stuck open. Clean valve.
2. The heater has failed. Check for a bad heating element, or a heater contact that failed in the open position.

PHS

Err

**The incoming power is out of phase. A leg may have failed or is disconnected.**

1. The pump is rotating in the wrong direction. Reverse any two leads on the power connection.
2. Check fuses or circuits at the main power supply.

Pbr

Err

**The return line temperature probe failed. Check for loose connections, or replace.**

PbS

Err

**The supply line temperature probe failed. Check for loose connections, or replace.**

FUS

002

**The pump fuse failed. Replace the fuse on the motherboard.**

**NOTE:** See the Thermolator User Guide for additional alarm messages regarding fuses and controller errors.

## Warning alarms

The Thermolator continues operating, but this problem could lead to a shutdown condition if not corrected.

Low Deviation

**Actual temperature of water supplied to the mold is lower than the setpoint deviation limit allows.**

1. Low deviation temperature is set too low. Increase.
2. The heater failed. Check for a bad heating element or a heater contact that failed in the open position.
3. The cooling valve is stuck open. Clean valve as needed.

High Deviation

**Actual temperature of water supplied to the mold is higher than the setpoint deviation limit allows.**

1. High deviation temperature is set too low. Increase.
2. Water has stopped flowing between supply outlet and return inlet. Check for plugged pipe or failed cooling valve.
3. The heater contact failed. Replace the contactor.
4. The heater and lines may be too large for this application.

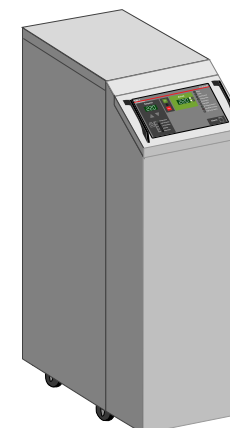
SPI Communication

## Quick Card

# Thermolator® vacuTrac

Positive/Negative Water  
Temperature Controller  
with TW-1 Microprocessor

Basic  
Operation  
Troubleshooting



Instant Access Parts  
& Service:  
(800) 458-1960  
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**CONAIR**

The Conair Group, Inc.  
One Conair Drive  
Pittsburgh, PA 15202  
Phone: (412) 312-6000  
Fax: (412) 312-6001

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


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## THE TW-2 CONTROL

## OPERATION

### Starting the Thermolator®.

- 1 Turn on main power to the Thermolator®.**
  - ◆ Setpoint and actual windows display **888** for three seconds, then display the most recently entered setpoint temperature and the current actual temperature.
  - ◆ Indicator lights blink green, then red.
- 2 Turn on water supply to the unit.**  
If the water supply is on, go to Step 3.
- 3 Enter the temperature setpoint.**  
Press the Setpoint  until the green light appears next to Temperature. Press  to increase the setpoint or  to decrease.
- 4 Press .**
  - ◆ The RUN/STOP light turns green.
  - ◆ The unit initiates a 60-second venting sequence. Cooling and venting valves are active for 60 seconds. The pump is active for the final 30 seconds.
  - ◆ Normal operation begins. The heater turns on if the actual temperature is below setpoint. The cooling valve remains active if the actual temperature is above setpoint.

If the Alarm light turns on, press  to silence an audible alarm and go to the Troubleshooting section.

### Stopping the Thermolator®.




- 1 Press .**
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#### Setpoint display

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#### Run/Stop

Press the RUN button to start normal operation. Press STOP to stop the temperature control unit.




-  = Running
-  = Stopped
-  = Alarm (flashing)

#### Actual values display



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#### Status lights




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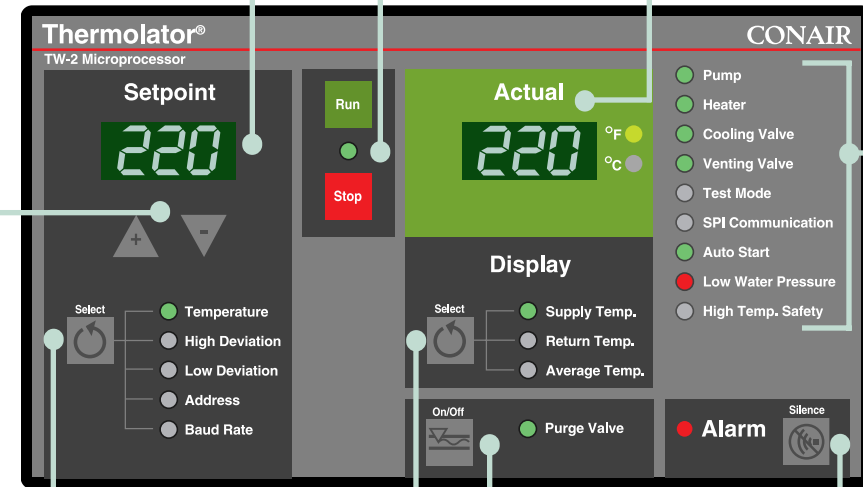
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-  = Test Mode off
-  = Test Mode on; unit disabled

**Auto Start** allows you to start and stop the Thermolator® from a remote switching or timing device, such as the processing machine control. This feature can only be enabled by configuring a dip switch on the control otherboard.

-  = Disabled; Auto Start not available
-  = (flashing) Enabled; unit can start at any time
-  = On and under control of



#### Setpoint Select button





Press repeatedly until a green light appears next to the parameter you want to program or view.

**NOTE:** Default settings for the deviation setpoints are:

High = setpoint + 10° F  
Low = setpoint - 10° F

A warning alarm occurs (indicator light turns red) whenever the actual temperature is outside this setpoint range. Recommend setting:  $\pm 2-10^\circ$ .

#### Setpoint adjustment buttons

Press  or  to enter temperature and SPI parameters. Press  to increase a value. Press  to decrease a value.

**TIP:** Press and hold the button for faster scrolling speed.

#### Alarm

Press to acknowledge the alarm light and silence the optional audible alarm. The alarm light will flash until the cause of the alarm condition is fixed.

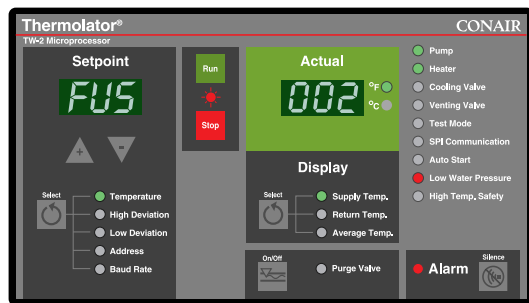
#### Purge On/Off

The purge option is not available on positive/negative pressure water temperature controllers.

#### Display Select button

Press repeatedly until a green light appears next to the parameter you want to program or view in the Actual values window. See the User Guide for programming information.

## TROUBLESHOOTING



If there is a problem, the Thermolator® activates the red Alarm light and changes the RUN/STOP light from green to flashing red.

**1** Press to silence the optional audible alarm.

**2** Check the indicator lights and messages to help determine the cause of the problem.

Pump



**WARNING: Before servicing the Thermolator®**

Allow the unit to cool to below 100° F. Disconnect and lockout the main power source. Disconnect water and air supply lines.

## Shut down alarms

The Thermolator has shut down automatically to prevent damage to equipment or personnel. To resume normal operation, press **Stop**, fix the problem, then press **Run**.

Pump

**The pump overload has tripped. Contact is open.**

1. Verify that the correct voltage is supplied to the motor.
2. Water flow may be more than the pump can handle. Check current draw against motor rating. Decrease flow as needed.

Low Water Pressure

**The supply water level is low.**

1. Verify that the water supply is turned on.

**NOTE:** The low water pressure alarm does not require manual reset. It will reset automatically when the water level is sufficient.

High Temp. Safety

**The actual temperature of water supplied to the mold exceeds the 190° F temperature safety switch limit.**

1. The unit is not running. Start the Thermolator.
2. Water has stopped flowing between supply outlet and return inlet. Check for closed valve or plugged line.
3. The heater contactor failed. Replace contactor.

**Actual temperature of water supplied to the mold is higher than the programmed 190° F safety limit.**

1. Water has stopped flowing between supply outlet and return inlet. Check for closed valve or plugged line.
2. The heater contactor failed. Replace contactor.

**Actual temperature of water supplied to the mold is below the programmed 20° F safety limit.**

1. The cooling valve is stuck open. Clean valve.
2. The heater has failed. Check for a bad heating element, or a heater contact that failed in the open position.

**The incoming power is out of phase. A leg may have failed or is disconnected.**

1. The pump is rotating in the wrong direction. Reverse any two leads on the power connection.
2. Check fuses or circuits at the main power supply.

**The return line temperature probe failed.** Check for loose connections, or replace.

**The supply line temperature probe failed.** Check for loose connections, or replace.

**The pump fuse failed.** Replace the fuse on the motherboard.

**NOTE:** See the Thermolator User Guide for additional alarm messages regarding fuses and controller errors.

## Warning alarms

The Thermolator continues operating, but this problem could lead to a shutdown condition if not corrected.

Low Deviation

**Actual temperature of water supplied to the mold is lower than the setpoint deviation limit allows.**

1. Low deviation temperature is set too low. Increase.
2. The heater failed. Check for a bad heating element or a heater contact that failed in the open position.
3. The cooling valve is stuck open. Clean valve as needed.

High Deviation

**Actual temperature of water supplied to the mold is higher than the setpoint deviation limit allows.**

1. High deviation temperature is set too low. Increase.
2. Water has stopped flowing between supply outlet and return inlet. Check for plugged pipe or failed cooling valve.
3. The heater contact failed. Replace the contactor.
4. The heater and lines may be too large for this application.

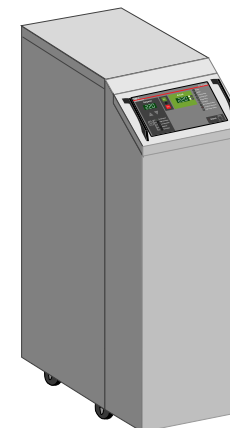
SPI Communication

## Quick Card

# Thermolator® vacuTrac

Positive/Negative Water  
Temperature Controller  
with TW-2 Microprocessor

Basic  
Operation  
Troubleshooting



**CONAIR**™

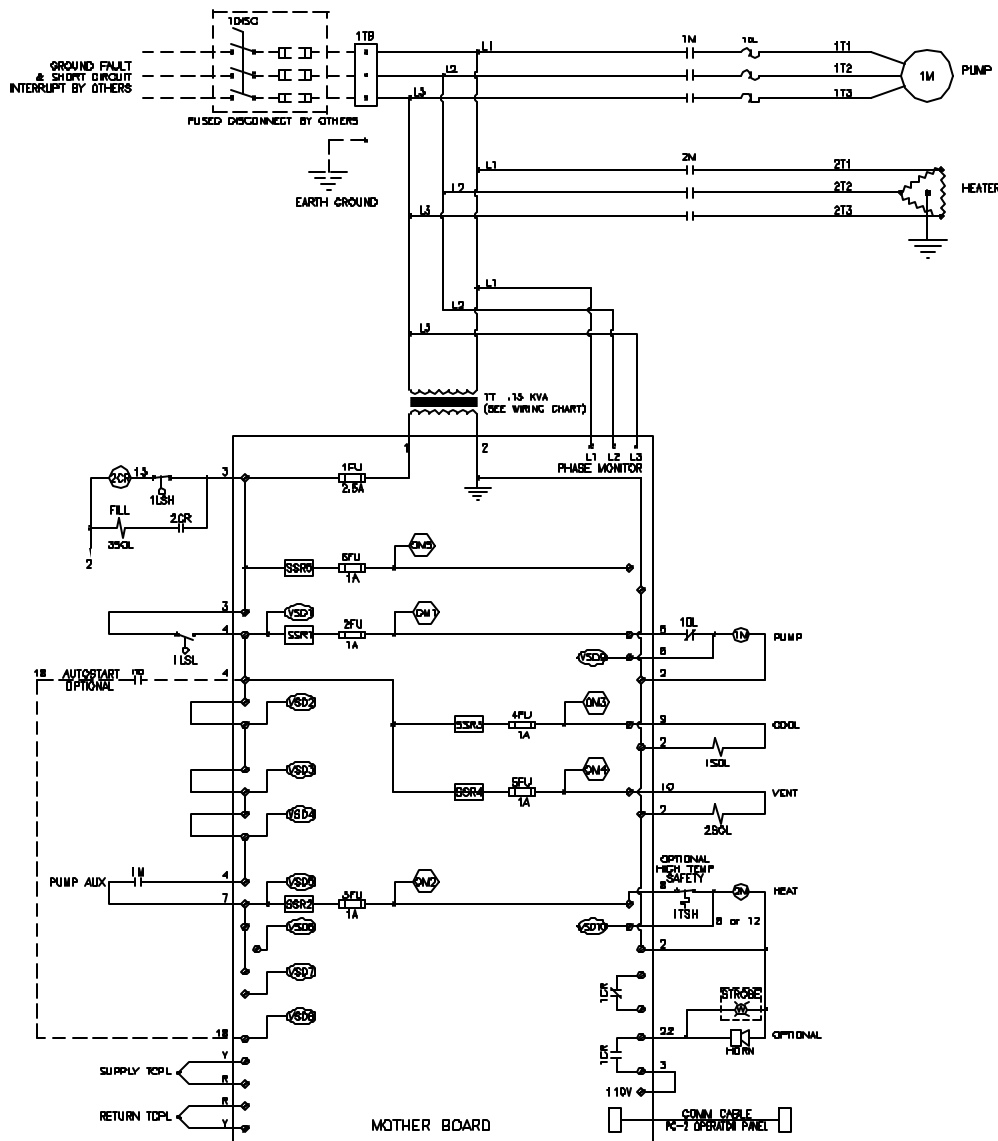
The Conair Group, Inc.  
One Conair Drive  
Pittsburgh, PA 15202  
Phone: (412) 312-6000  
Fax: (412) 312-6001

Instant Access Parts  
& Service:  
(800) 458-1960  
(814) 437-6861

www.conairnet.com

QCH006/1197

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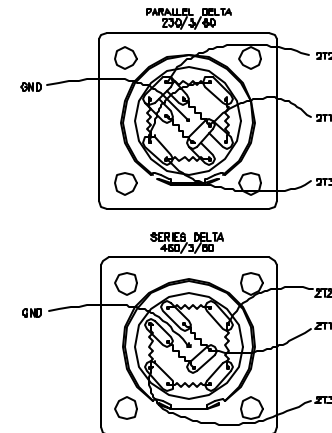
#### LEGEND:

- TD - TIME DELAY RELAY/CONTACTS
- LSL - LOW LEVEL SWITCH
- LSH - HIGH LEVEL SWITCH
- PSL - LOW PRESSURE SWITCH
- PSH - HIGH PRESSURE SWITCH
- TSL - LOW TEMPERATURE SWITCH
- TSH - HIGH TEMPERATURE SWITCH
- VSD - VOLTAGE SENSING DEVICE
- SSR - SOLID STATE RELAY
- OM - OUTPUT MONITOR
- DPST - DIFFERENTIAL PRESSURE SWITCH LOW

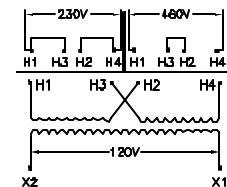
#### NOTES:

INSTRUMENTS SHOWN WITH ELECTRICAL CONTACTS IN THE UNPOWERED, UNFORCED AMBIENT 70°F CONDITION IN THE "AS INSTALLED MOUNTING ORIENTATION"

#### HEATER TERMINAL WIRING PATTERNS



#### CONTROL TRANSFORMER WIRING CHART



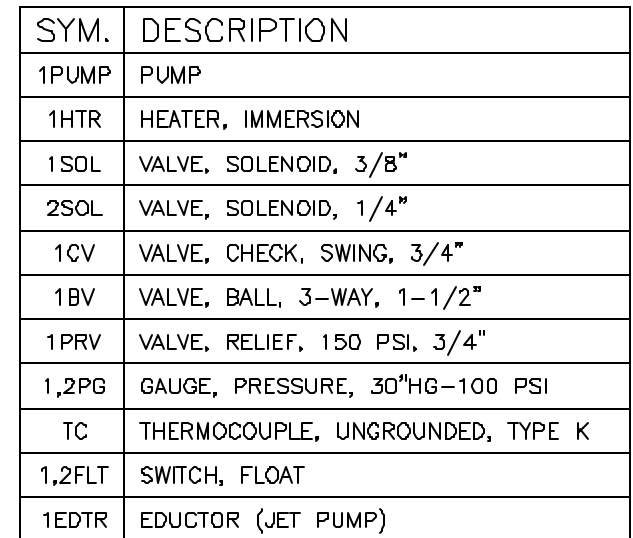
**CONAIR**

The Conair Group Inc  
One Conair Drive  
Pittsburgh, PA 15202 A

### VACUTRAC TW-2 WIRING SCHEMATIC (230/480 V)

DRAWN BY:	WJS	DATE:	09-28-98
SHEET:	1 OF 1	DWG NO.:	33405308
REV:	D		

D	SML	460V TAPS ON TRANSFORMER	03-26-01	SML
C	SML	TRANSFORMER WIRING CHART	08-03-00	SML
REV	BY	DESCRIPTION	DATE	APP



DRAWN BY: SML		DATE: 01-15-02	
SHEET: 1 OF 1		DWG NO.: VTR FLOW DIAG	
		REV: A	

A	SML	INITIAL RELEASE	01-15-02	SML
REV	BY	DESCRIPTION	DATE	APP



## *User Guide*

# Thermolator®

## TW-1 and TW-2

### Water Temperature Control Units

*Installation*

*Operation*

*Maintenance*

*Troubleshooting*



*Instant Access  
Parts and Service  
(800) 458-1960  
(814) 437-6861*

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The Conair Group, Inc.  
One Conair Drive  
Pittsburgh, PA 15202  
Phone: (412) 312-6000  
Fax: (412)-312-6320

UGH015/0100



---

*Please record your equipment's model and serial number(s) and the date you received it in the spaces provided.*

It's a good idea to record the model and serial number(s) of your equipment and the date you received it in the User Guide. Our service department uses this information, along with the manual number, to provide help for the specific equipment you installed.

Please keep this User Guide and all manuals, engineering prints and parts lists together for documentation of your equipment.

<b>Date:</b>
<b>Manual Number:</b> UGH015/0100
<b>Serial number(s):</b> ..... .....
<b>Model number(s):</b> ..... .....

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---

# INTRODUCTION

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no one gets hurt . . . . .1-3*

---

## PURPOSE OF THE USER GUIDE

This User Guide describes the Conair Thermolator® TW-1 and TW-2 water temperature control units and explains step-by-step how to install, operate, maintain and repair this equipment.

Before installing this product, please take a few moments to read the User Guide and review the diagrams and safety information in the instruction packet. You also should review manuals covering associated equipment in your system. This review won't take long, and it could save you valuable installation and operating time later.

---

## HOW THE GUIDE IS ORGANIZED

Symbols have been used to help organize the User Guide and call your attention to important information regarding safe installation and operation.



Symbols within triangles warn of conditions that could be hazardous to users or could damage equipment. Read and take precautions before proceeding.



Numbers within shaded squares indicate tasks or steps to be performed by the user.



A diamond indicates the equipment's response to an action performed by the user.



An open box marks items in a checklist.



A shaded circle marks items in a list.

---

## YOUR RESPONSIBILITY AS A USER

You must be familiar with all safety procedures concerning installation, operation and maintenance of this equipment. Responsible safety procedures include:

- Thorough review of this User Guide, paying particular attention to hazard warnings, appendices and related diagrams.
- Thorough review of the equipment itself, with careful attention to voltage requirements, intended uses and warning labels.
- Thorough review of instruction manuals for associated equipment.
- Step-by-step adherence to instructions outlined in this User Guide.

We design equipment with the user's safety in mind. You can avoid the potential hazards identified on this machine by following the procedures outlined below and elsewhere in the User Guide.

 **ATTENTION:**  
**READ THIS SO NO**  
**ONE GETS HURT**



**WARNING: Improper installation, operation or servicing may result in equipment damage or personal injury.**

This equipment should be installed, adjusted, and serviced by qualified technical personnel who are familiar with the construction, operation and potential hazards of this type of equipment.

All wiring, disconnects and fuses should be installed by qualified electrical technicians in accordance with electrical codes in your region.

Always maintain a safe ground. A properly sized conductive ground wire from the incoming power supply must be connected to the chassis ground terminal inside the electrical enclosure. Improper grounding can result in personal injury and erratic machine operation.

Do not operate the equipment at power levels other than what is specified on the the equipment serial tag and data plate.



**WARNING: Electrical shock hazard**

This equipment is powered by three-phase main voltage, as specified on the machine serial tag and data plate.

Always disconnect and lock out the incoming main power source before opening the electrical enclosure or performing non-standard operating procedures, such as troubleshooting or maintenance. Only qualified personnel should perform procedures that require access to the electrical enclosure while power is on.



**CAUTION: Hot surfaces**

Surface temperatures inside the Thermolator can exceed 250° F (121° C). Always allow the unit to cool to below 100° F (38° C) before opening, servicing or disassembling the unit.

---

 **ATTENTION:**  
**READ THIS SO NO**  
**ONE GETS HURT**



**WARNING: Hazardous substance**

The electrical contactors in the Thermolator have mercury contactors. Mercury is considered a hazardous substance and must be dealt with accordingly. Material Safety Data Sheet (#7439-97) has been included in the instruction packet. This sheet explains the potential hazards, how to avoid them and how to clean up and dispose of the mercury if it spills.

---

## DESCRIPTION

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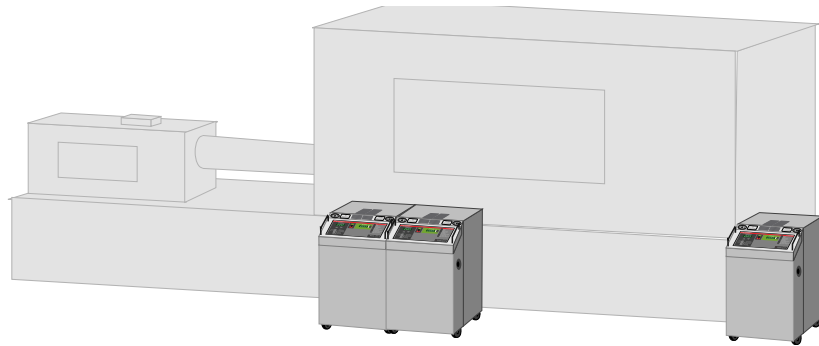


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# WHAT IS THE THERMOLATOR ?

The Thermolator TW models circulate water at a temperature higher than the available water supply, to add or remove heat as needed to maintain a uniform temperature setpoint in the process. The TW-2 offers an enhanced control, with additional diagnostic features and autostart capabilities.

Both the TW-1 and TW-2 models are available in single or multiple-zone configurations, using direct injection or closed circuit process heating and cooling. Multiple-zone models can control up to three temperatures at different locations in the process. Two- and three-zone models have common cooling water manifolds and electrical connections.



---

## TYPICAL APPLICATIONS

The best model for your application depends on the process temperature you need to maintain and the quality of the cooling water supply.

**Direct injection (DI) models** control the temperature by discharging heated process water and adding cooling water directly from the water supply. DI models are designed for:

- Process temperatures up to 250°F (121°C).
- Use with chiller water or properly treated and filtered tower or city water.

**Closed circuit (CC) models** add cooling water to the process loop only during the initial filling or when make-up water is needed. CC models are recommended for:

- Process temperatures 180°F (82°C) to 250°F (121°C).
- Use with contaminated cooling water, or with properly treated and filtered tower or city water..

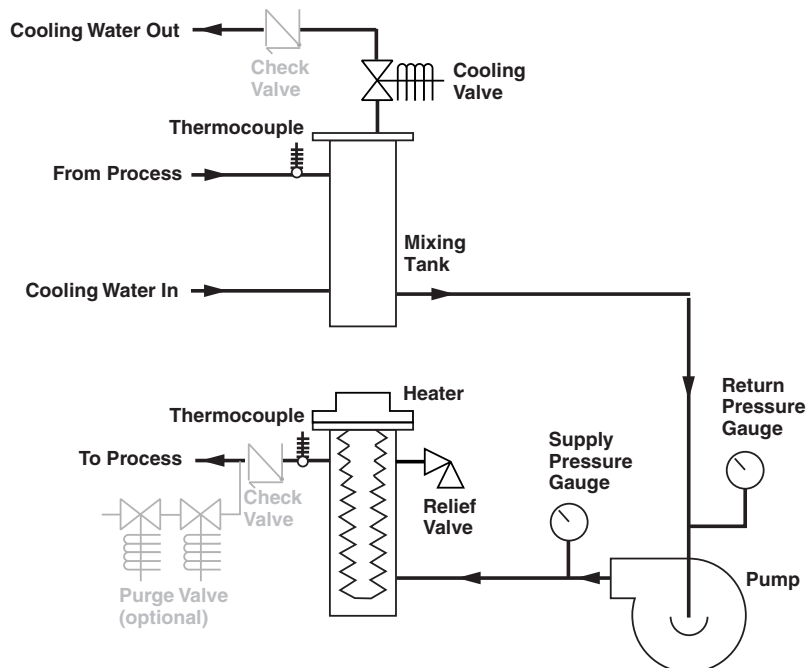
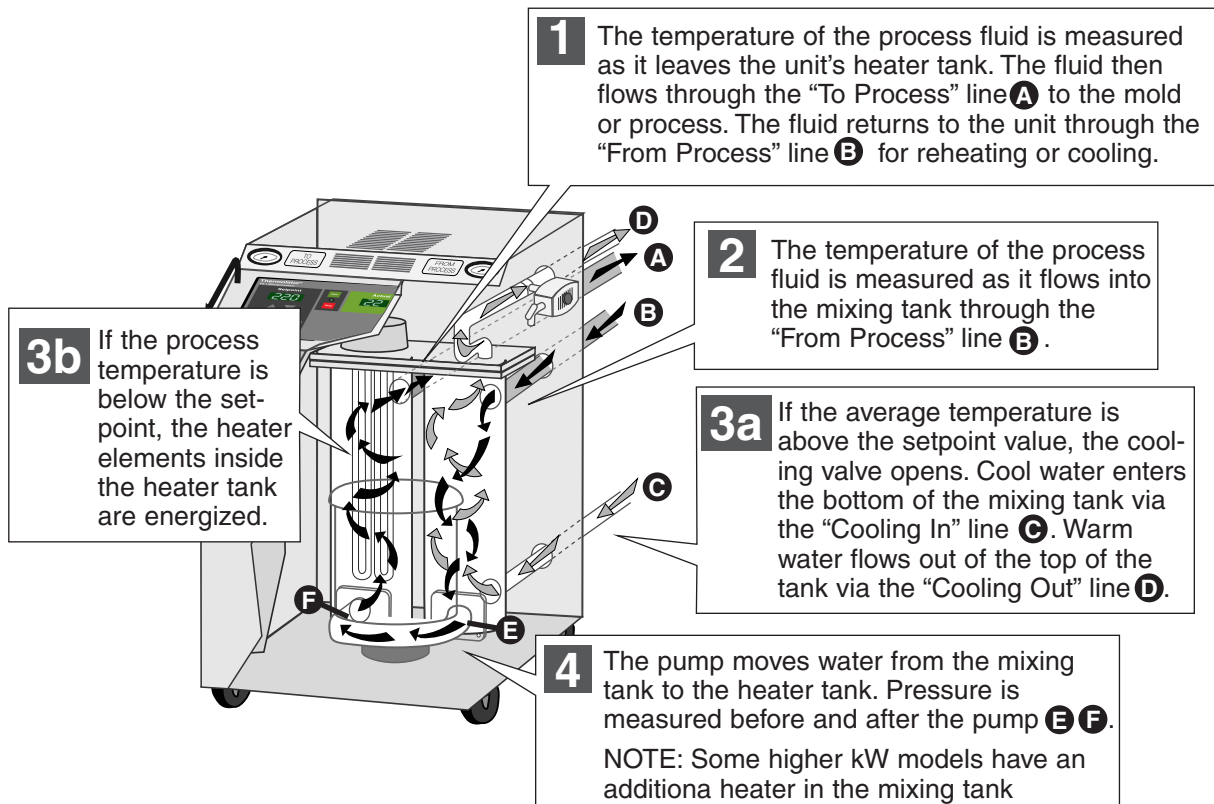
**Isolated circuit (IC) models** separate the cooling water from the process fluid, which is held in a reservoir. IC models are recommended for:

- Process temperatures up to 180°F (82°C).
- Use with contaminated cooling water or a process fluid mixture of water and glycol.

**IMPORTANT:** Do not use deionized water or glycol mixtures containing additives in a Thermolator. Softened water or glycol mixtures with additives, such as automotive fluids, can damage the Thermolator. Glycol/water process loop mixtures should use industrial-grade ethylene glycol only.

Direct injection models maintain the process temperature by electrically heating and injecting cool water supplied to the Thermolator by a chiller, tower or other water source.

## How It Works: DIRECT INJECTION

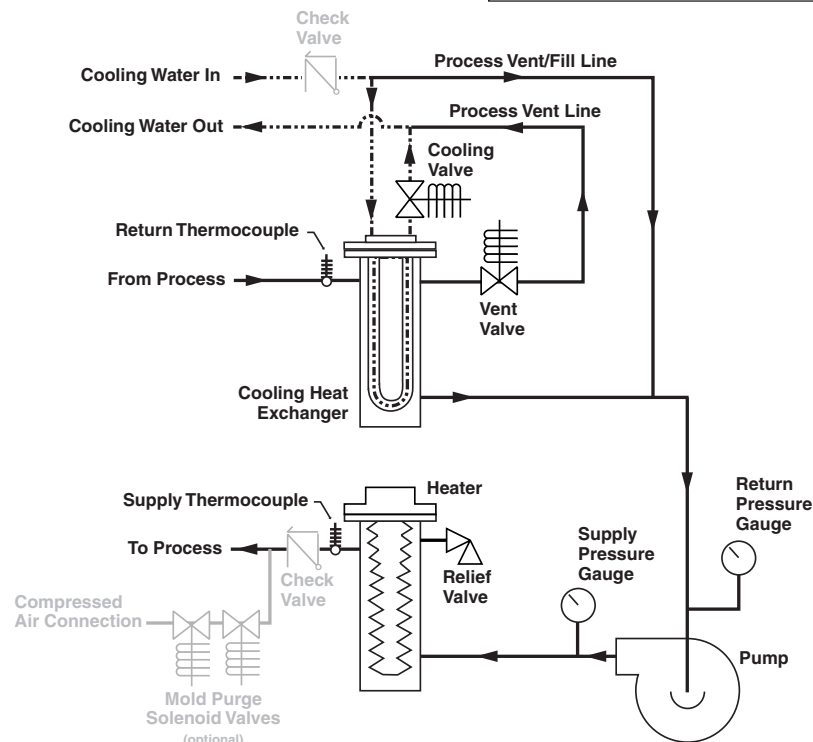
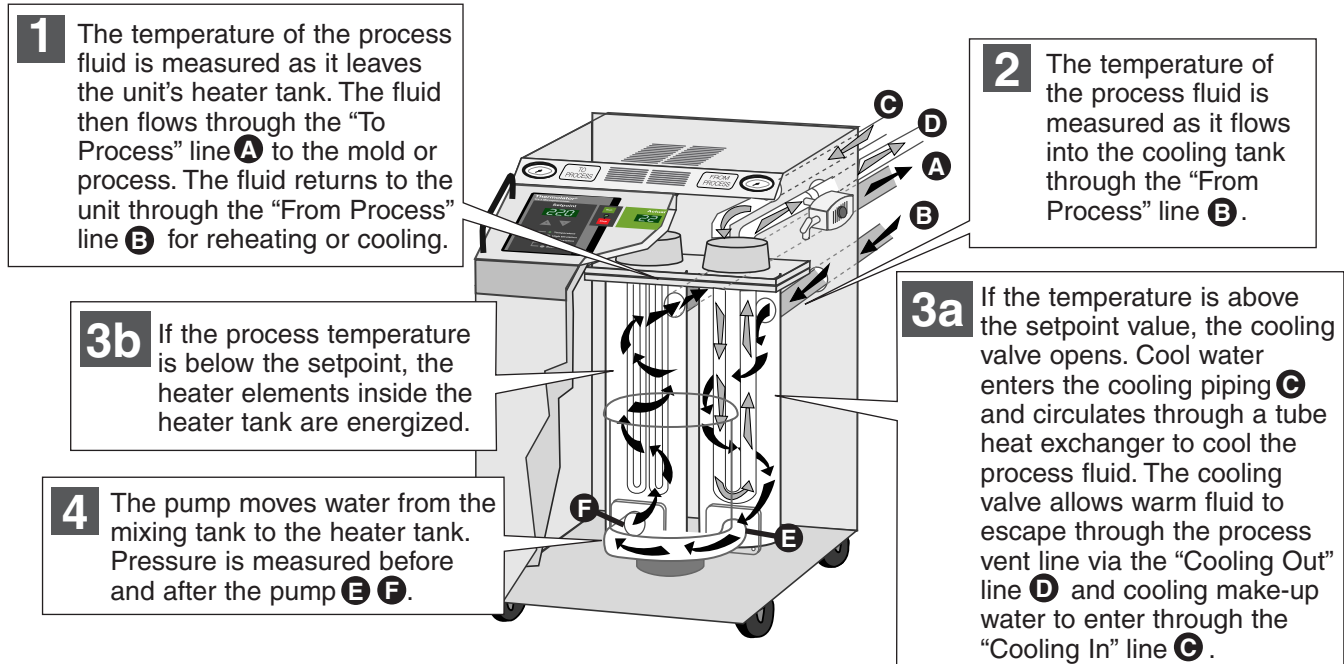


### Direct Injection

Check valves included only with optional mold purge.

# How It Works: CLOSED CIRCUIT

Closed Circuit models maintain the process temperature by heating and cooling fluid for the process circuit. Cooling water supplied by a chiller, tower or other water source, is mixed with the process fluid only during the initial filling or when water is needed to make up process fluid loss.

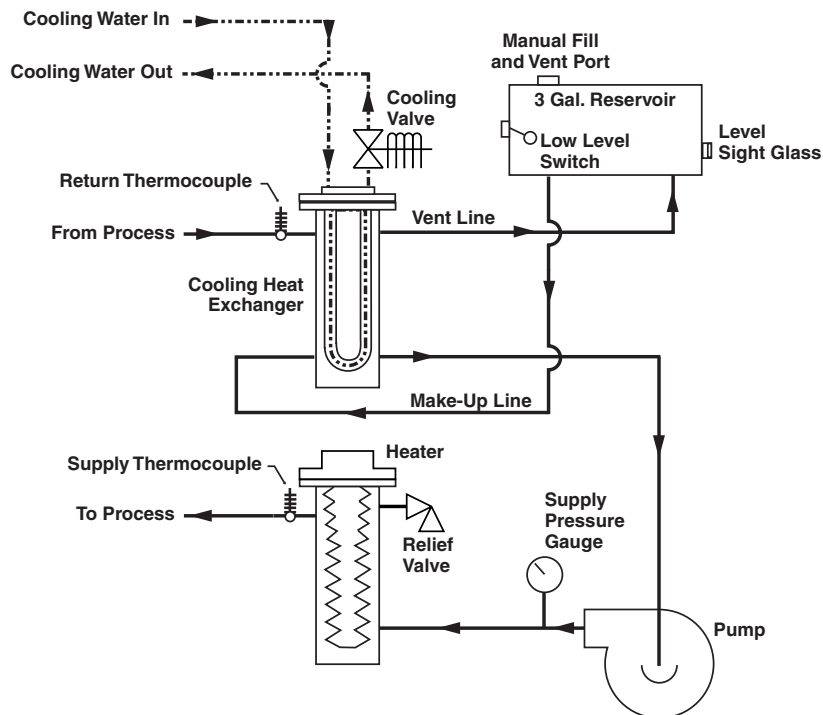
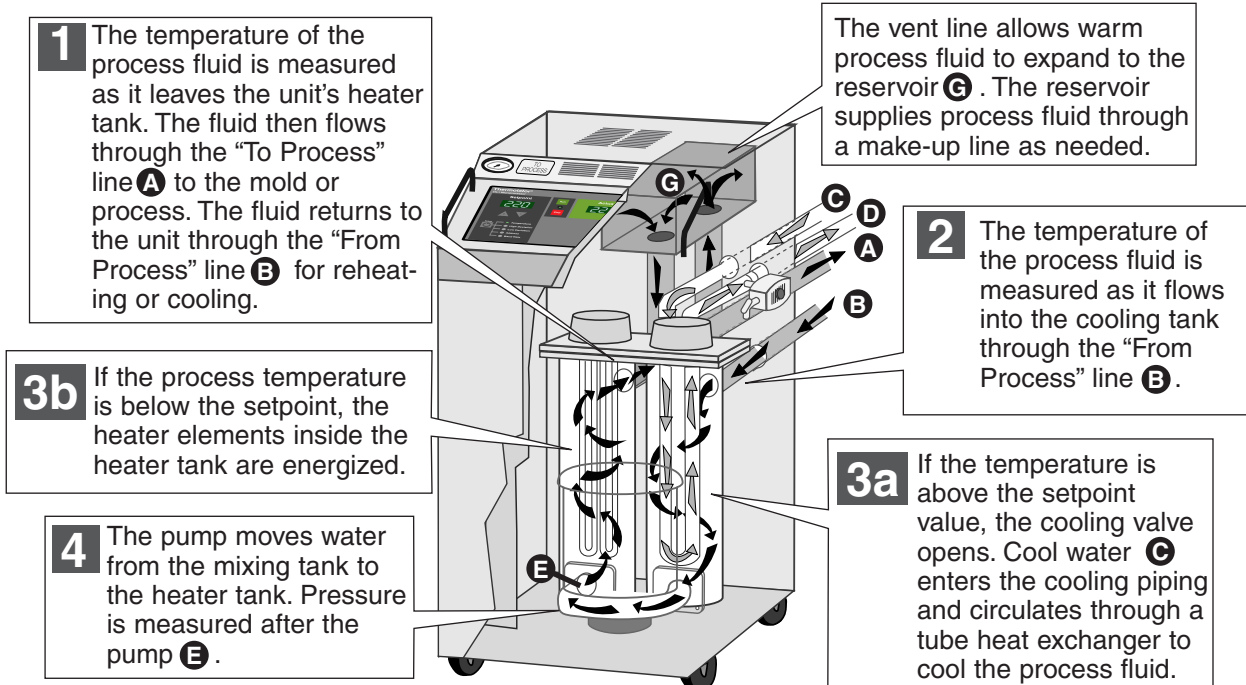


## Closed Circuit

Check valves included only with optional mold purge.

Isolated Circuit models maintain the process temperature by heating and cooling fluid for the process circuit. The process fluid, which is stored in a reservoir, is isolated from cooling water supplied by a chiller, tower or other source

## How It Works: ISOLATED CIRCUIT



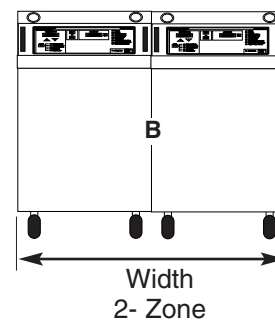
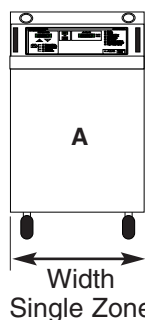
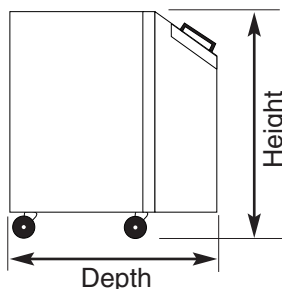
### Isolated Circuit

NOTE: There is a 180° F operating temperature limit on isolated circuit units.

# SPECIFICATIONS

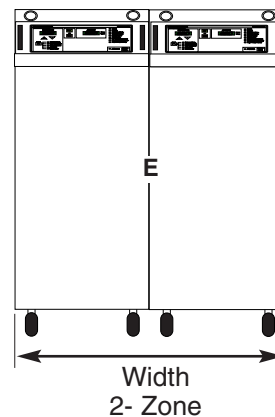
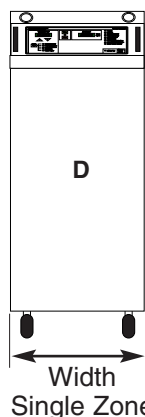
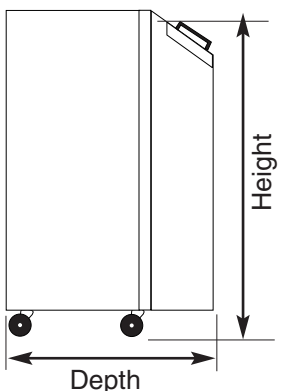
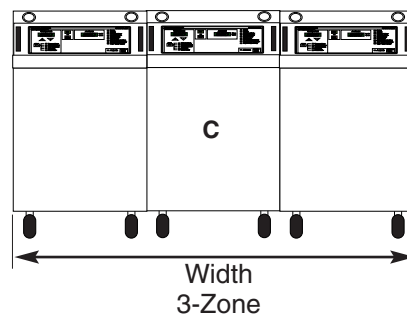
Dimensions and performance characteristics vary according to the model, voltage and components selected. See the cabinet style reference chart to determine dimensional information for your specific model. Additional technical information can be found in the Appendix of this User Guide.

CABINET STYLE REFERENCE				
Heater	Voltage Selection	Single Zone	2 Zone	3 Zone
<b>Direct Injection (DI)</b>				
9, 12, 18 or 24 kW	208, 230, 460, 575	A	B	C
36 kW	208 or 230	D	E	N/A
36 kW	460 or 575	A	B	C
48 kW	208, 230, 460, 575	D	E	N/A
<b>Closed Circuit (CC)</b>				
9 or 12 kW	208, 230, 460, 575	A	B	C
18 or 24 kW	208, 230, 460, 575	D	E	N/A
<b>Isolated Circuit (IC)</b>				
9, 12, 18 or 24 kW	208, 230, 460, 575	D	E	N/A

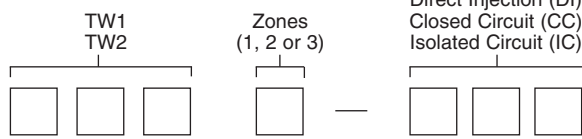


WATER CONNECTIONS	
All models	
NPT inches (female)	
From process	1.25
Cooling water in/out	0.75

**NOTE:** 2-zone and 3-zone models have common wiring and plumbing.



## MODEL DESIGNATIONS



# SPECIFICATIONS

PERFORMANCE CHARACTERISTICS - *Lower operating temperatures can be obtained with larger cooling valves. Consult your Conair representative.			
Models	TW1 -DI or TW2 -DI	TW1 -CC or TW2 -CC	TW1 -IC or TW2 -IC
Minimum Setpoint Temperature °F {°C}	32 {0}	32 {0}	32 {0}
Maximum Setpoint Temperature °F {°C}	250 {121}	250 {121}	180 {82}
Minimum Operating Temperature °F {°C}	Approximately 20° {11°} above the cooling water inlet temperature*		
Standard Cooling Valve Size inches {mm}	1/4 {6.35}	3/4 {19.05}	3/4 {19.05}
Available pump sizes	0.75, 1, 2, 3, 5 or 7.5 Hp {0.56, 0.75, 1.49, 2.24, 3.73 or 5.59 kW}		
Available heater sizes	9, 12, 18, 24, 36 or 48 kW		

PUMP PERFORMANCE - Consult your Conair representative for pump performance characteristics at other operating points.						
Pump	3/4 HP {0.56 kW}	1 HP {0.75 kW}	2 HP {1.49 kW}	3 HP {2.24 kW}	5 HP {3.73 kW}	7.5 HP {5.59 kW}
Nominal Flow gpm {lpm}	40 {151}	45 {170}	55 {208}	80 {303}	100 {379}	115 {435}
Pressure@ Nominal Flow psi {kg/cm²}	17 {1.2}	18 {1.3}	31 {2.2}	35 {2.5}	43 {3}	51 {3.6}

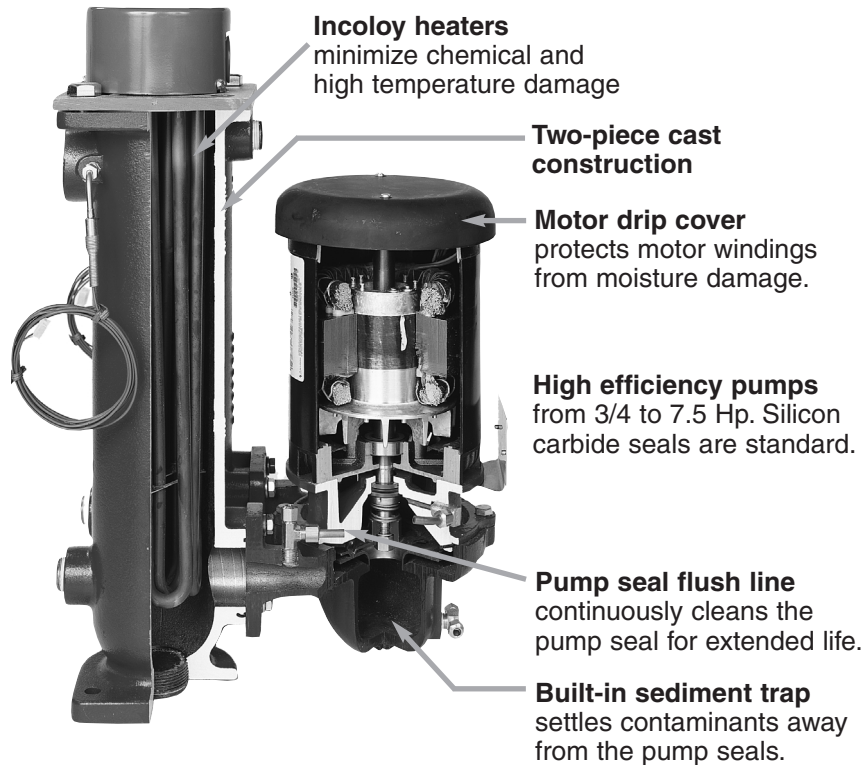
DIMENSIONS in. {mm}					
Cabinet Style	A	B	C	D	E
Height	28.0 {710}	28.0 {710}	28.0 {710}	43.0 {1090}	43.0 {1090}
Depth	22.5 {570}	22.5 {570}	22.5 {570}	31.5 {800}	31.5 {800}
Width	13.75 {350}	27.5 {700}	41.25 {1050}	14.0 {355}	28.0 {710}

SHIPPING WEIGHT RANGES lbs {kg} Weights vary depending on cabinet size and cooling type (DI, CC or IC).						
Pump	Single Zone		2 Zone		3 Zone	
	Min	Max	Min	Max	Min	Max
0.75 HP {0.56 kW}	240 {109}	300 {136}	480 {218}	600 {272}	720 {327}	840 {381}
1 HP {0.75 kW}	240 {109}	300 {136}	480 {218}	600 {272}	720 {327}	840 {381}
2 HP {1.49 kW}	250 {113}	310 {141}	500 {226}	620 {282}	750 {336}	870 {396}
3 HP {2.24 kW}	260 {118}	320 {145}	520 {236}	640 {290}	780 {354}	900 {408}
5 HP {3.73 kW}	270 {122}	330 {150}	540 {244}	660 {300}	810 {366}	930 {423}
7.5 HP {5.59 kW}	280 {127}	340 {154}	560 {254}	680 {308}	840 {381}	960 {435}

TOTAL FULL LOAD AMPS PER ZONE																								All voltages are 3 phase, 60 Hz.											
Heater		9 kW				12 kW				18 kW				24 kW				36 kW				48 kW													
Voltage		208V	230V	460V	575V	208V	230V	460V	575V	208V	230V	460V	575V	208V	230V	460V	575V	208V	230V	460V	575V	208V	230V	460V	575V										
Pump																																			
0.75 HP	{0.56 kW}	28.9	26.2	13.1	10.5	37.3	33.8	16.9	13.5	54.0	48.8	24.4	19.5	70.7	64.0	32	25.6	104.0	94.0	47.0	37.6	137.0	124.0	62.1	49.7										
1 HP	{0.75 kW}	29.4	26.6	13.3	10.6	37.8	34.2	17.1	13.7	54.4	49.2	24.6	19.7	71.2	64.4	32.2	25.8	104.3	94.4	47.2	37.8	137.7	124.6	62.3	49.6										
2 HP	{1.49 kW}	31.8	28.8	14.4	11.5	40.2	36.4	18.2	14.6	56.8	51.4	25.7	20.6	73.6	66.6	33.3	26.6	106.7	96.6	48.3	38.6	140	126.8	63.4	50.7										
3 HP	{2.24 kW}	34.7	31.4	15.7	12.6	43.1	39.0	19.5	15.6	59.7	54.0	27.0	21.6	76.5	69.2	34.6	27.7	109.6	99.2	49.6	39.7	143	129.4	64.7	51.8										
5 HP	{3.73 kW}	38.5	34.8	17.4	13.9	46.9	42.4	21.2	17.0	63.4	57.4	28.7	23	80.2	72.6	36.3	29.0	113.4	102.6	51.3	41.0	146.7	132.8	66.4	53.1										
7.5 HP	{5.59 kW}	45.7	41.4	20.7	16.6	54.1	49.0	24.5	19.6	70.7	64.0	32.0	25.6	87.5	79.2	39.6	31.7	120.7	109.2	54.6	43.7	154	139.4	69.7	55.8										

TOTAL FULL LOAD AMPS PER ZONE All voltages are 3 phase, 60 Hz.									
Heater		0 heaters							
Voltage		208V	230V	460V	575V				
Pump									
0.75 HP {0.56 kW}		3.9	3.6	2.3	1.5	<b>NOTE: Thermolators can be ordered without heaters for certain applications.</b>			
1 HP {0.75 kW}		4.4	4.0	2.5	1.6				
2 HP {1.49 kW}		6.8	6.2	3.6	2.5				
3 HP {2.24 kW}		9.7	8.8	4.9	3.6				
5 HP {3.73 kW}		13.5	12.2	6.6	4.9				
7.5 HP {5.59 kW}		20.7	18.8	9.9	7.6				

# FEATURES AND OPTIONS



## OPTIONS



### Motorized Cooling Valve

Eliminates thermal shock from your process circuit by modulating the cooling water.



### Compressed Air Mold Purge

Quickly evacuates fluid from the process circuit, allowing for faster, cleaner disconnection of the temperature controller from molds and hoses.



### Alarm packages

The Thermolator control includes an output relay that can be connected to an optional external alarm package to call attention to alarm conditions.



### Stacking Rack

Save floor space by stacking Thermolators two-high. The stacking rack can be used only with single-zone models in 28-inch high cabinets.



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# INSTALLATION

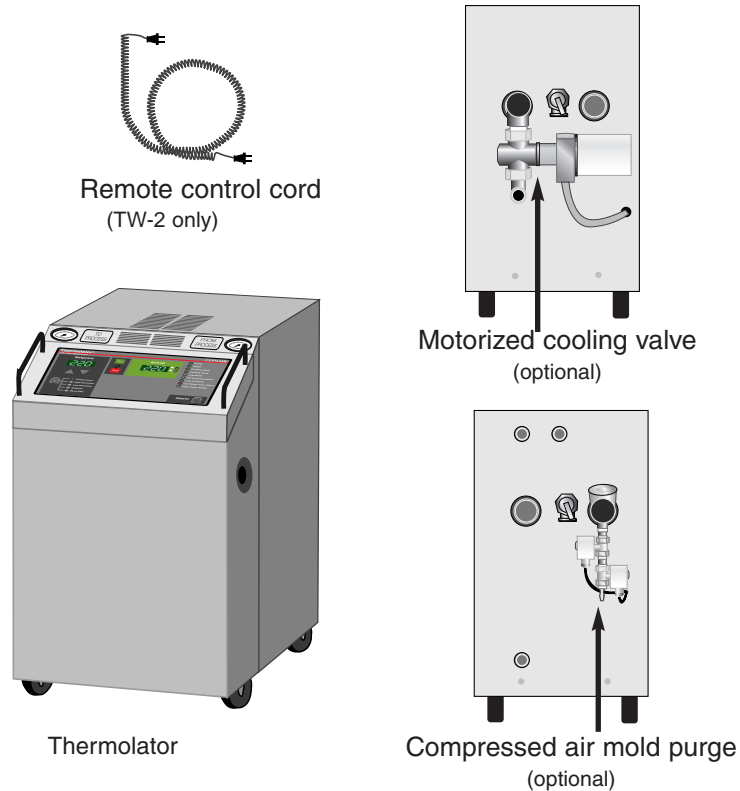
- *Unpacking the boxes . . . . .3-2*
- *Preparing for installation . . . . .3-3*
- *Connecting the water supply . .3-4*
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- *Testing the installation . . . . .3-7*
- *Initial setup . . . . .3-8*
- *Changing temperature units . . .3-9*
- *Enabling and disabling  
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- *Selecting the temperature  
    control point (TW-2) . . . . .3-12*
- *Entering setpoint  
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- *Activating SPI  
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- *Installing the Auto Start  
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# UNPACKING THE BOXES

Thermolator TW models come fully assembled. If they were specified at the time of the order, the optional purge valve or motorized cooling valve is factory-installed.

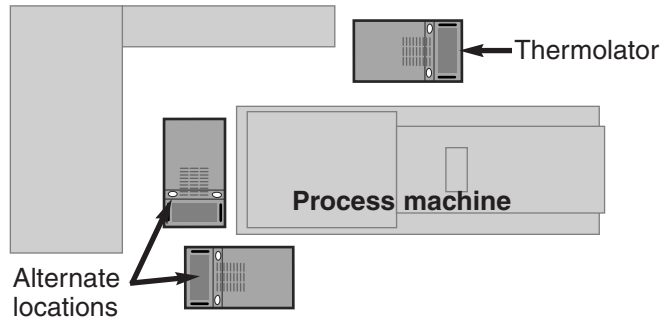


- 1** Carefully remove the **Thermolator** and components from their shipping containers, and set upright.
- 2** Remove all **packing material**, protective paper, tape, and plastic. Check inside the electrical enclosure and behind the side panels for accessories or hardware that may have been placed there for shipping.
- 3** Carefully **inspect all components** to make sure no damage occurred during shipping, and that you have all the necessary hardware. If damage is found, notify the freight company immediately.
- 4** Take a moment to **record serial numbers** and specifications in the blanks provided on the back of the User Guide's title page. The information will be helpful if you ever need service or parts.
- 5** You are now ready to begin installation. Complete the preparation steps on the next page.

The Thermolator is easy to install, if you plan the location and prepare the area properly.

## PREPARING FOR INSTALLATION

### 1 Position the Thermolator as close to the process machine as possible.



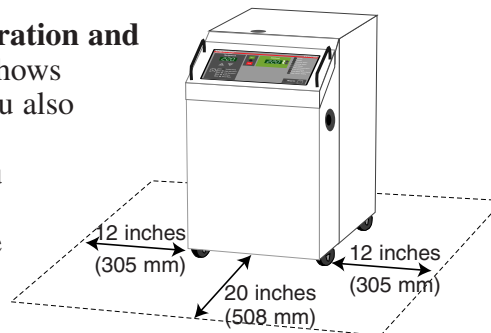
### 2 Make sure the installation area provides:

❑ **A three-phase power source supplying the correct current** for your Thermolator model. Check the serial tag on the side of the electrical enclosure for the required voltage, phase, frequency, full load amps, disconnect fuse size and minimum wire connection size. Field wiring should be completed by qualified personnel to the planned location for the Thermolator. All electrical wiring should comply with your region's electrical codes.

❑ **A clean, well-ventilated environment.**

The room temperature should not exceed 120° F (48° C) with 95% non-condensing humidity and should not fall below 32° F (0° C).

❑ **Minimum clearance for safe operation and maintenance.** The diagram at right shows minimum clearance for operation. You also need enough clearance in the rear for water hookups. For maintenance, you should move the Thermolator to provide at least 36 inches on any side of the Thermolator.



❑ **A source of water for cooling.**

City, tower or chiller water may be used, as long as the supply pressure is at least 25 psi and not more than 85 psi.

### 3 Install plumbing for process and cooling lines.

You will need two 1<sup>1</sup>/<sub>4</sub>-inch NPT male fittings for the process inlet and outlet and two 3/4-inch NPT male fittings for the cooling inlet and outlet. Larger line sizes are acceptable as long as they are reduced at the Thermolator connections. Smaller line sizes are not recommended.

# CONNECTING PROCESS AND WATER SUPPLY LINES

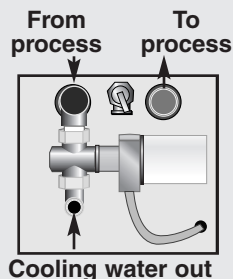
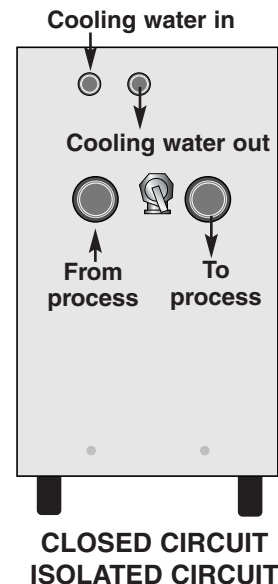
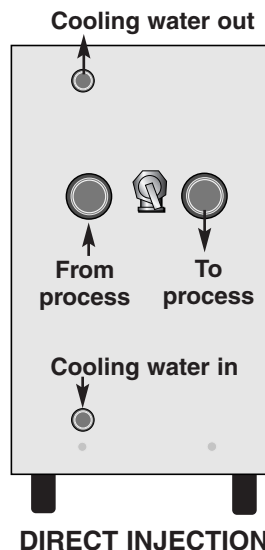
## Tools for installation:

- Pipe wrench large enough for a 2-inch pipe
- Premium quality Teflon thread sealant

**NOTE:** We recommend that you install an external ball valve on the cooling water inlet of the Thermolator. This valve is required when the purge valve option is installed.

The Thermolator process inlets and outlets must be connected to the plumbing that will circulate the temperature-controlled water or fluid through the process. Cooling water inlets and outlets are connected to the cooling water supply.

- 1 Remove the shipping pipe plug** from the female connections on the back of the Thermolator.
- 2 Install pipe to the rear of the Thermolator.**  
Use male 1 $\frac{1}{4}$ -inch NPT piping for process connections and male  $\frac{3}{4}$  inch NPT piping for water connections. Pipe and pipe threads must be clean and new. Clean threads with solvent, removing all oil, grease and dirt. Allow the threads to dry before proceeding.
- 3 Coat the pipe threads with thread sealant.**  
Follow the sealant manufacturer's directions.
- 4 Connect the male pipe to the appropriate female connection on the back of the unit.** Start by hand until the threads engage, then use a pipe wrench to tighten the connection only enough to prevent leaks. **Do not over-tighten!**



## Motorized Cooling Valve

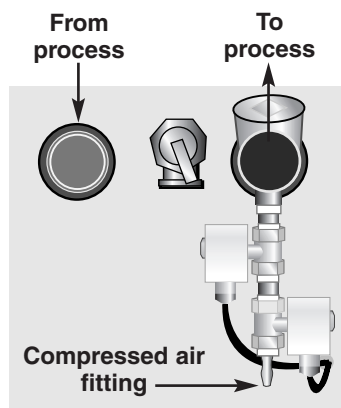
If you have the optional motorized cooling valve, connect the cooling water supply to the female  $\frac{3}{4}$  inch NPT fitting on the valve. except as noted, all other connections should be made as described above.

A purge valve is available as an option on Direct Injection and Closed Circuit units only. This valve quickly evacuates fluid from the process circuit, allowing faster disconnection of the temperature controller from molds and hoses. An optional manual purge button controls this valve on TW-1 models. TW-2 models have a purge button on the control panel.

## OPTIONAL PURGE VALVE HOOKUPS

If this option is ordered with the Thermolator, purge control wiring and installation of the valve on the process line outlet of the unit is completed at the factory. You still must connect process and cooling water inlets and outlets, as well as a supply of non-lubricated compressed air.

- 1 Remove the shipping pipe plug** from the female connections on the back of the Thermolator.
- 2 Install an external ball valve on the cooling water inlet of the Thermolator.** This valve is required when a purge valve is used.
- 3 Install pipe to the rear of the Thermolator.** Use male  $1\frac{1}{4}$ -inch NPT piping for process connections and male  $\frac{3}{4}$  inch NPT piping for water connections. Pipe and pipe threads must be clean and new. Clean threads with solvent, removing all oil, grease and dirt. Allow the threads to dry before proceeding.
- 4 Coat the pipe threads with thread sealant.** Follow the sealant manufacturer's directions.
- 5 Connect the male pipe to the appropriate female connection on the back of the unit.** Connect cooling water lines as indicated on the previous page. Connect process lines as indicated below. Start by hand until the threads engage, then use a pipe wrench to tighten the connection only enough to prevent leaks. **Do not over-tighten!**
- 6 Connect the purge valve to the compressed air supply.** The air pressure should not exceed 100 psi.



# CONNECTING THE MAIN POWER SUPPLY

**IMPORTANT:** Always refer to the wiring diagrams that came with your temperature control unit before making electrical connections. The diagrams show the most accurate electrical component information.



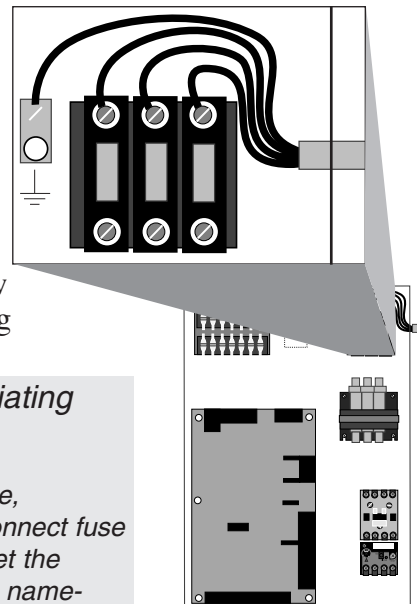
## WARNING: Electrical shock hazard

This equipment is powered by three-phase main voltage. Always disconnect and lock out the main power source before performing any work involving electrical connections. All wiring, disconnects and fusing should conform to your region's electrical codes and should be installed only by qualified personnel.

Before beginning, note the electrical specifications on the nameplate mounted to the side of the unit. The electrical hookup must match these specifications with +/- 10% maximum voltage variance. An improper power supply could damage the unit as well as seriously injure an operator.

The electrical hookup also should run through a fused disconnect sized for the nameplate amperage and conforming to Article 250 of the National Electrical Code.

- 1** Open the unit's electrical enclosure.
- 2** Insert the main power wire through the knockout hole in the right side of the enclosure.
- 3** Secure the power wire with a rubber compression fitting or strain relief.
- 4** Connect the power wires to the terminals.  
Connect the three hot wires to L1, L2, and L3 on the terminal block.
- 5** Connect the ground wire to the copper grounding mount.  
If you have installed a disconnect device, follow the manufacturer's wiring instructions.



## **IMPORTANT!** Before initiating power to the unit:

- ☐ Check the system for leaks.
- ☐ Verify that the voltage, phase, frequency, amperage, disconnect fuse and minimum wire size meet the specifications stated on the nameplate mounted on the side of the unit.
- ☐ Verify that resistance to ground on each phase is at least 1 meg ohm.



**WARNING: Only qualified personnel should perform this procedure.**

Parts of this test require opening the unit while it is energized. Only qualified personnel who have been trained in the use of electrical testing devices and in avoiding the safety hazards involved in safely troubleshooting this type of equipment should perform this test procedure.

## TESTING THE INSTALLATION

**1 Turn on the cooling water supply and check for leaks.** If any leaks appear, stop the test and fix the problem before continuing. The cooling water must be at least 25 PSI or the unit will not function. The LOW WATER PRESSURE light will come on when power is applied. The light goes off when the pressure is correct.

**2 Apply power to the unit.**

- ◆ Indicator lights on the control panel blink green, then red, to test operation of the LEDs.
- ◆ Setpoint and actual windows will display **888** for three seconds, followed by the software version. The windows then display the factory default setpoint of 100° F and the actual temperature.

**3 Check the rotation of the pump.** Remove the top access panel and the pump motor drip cover. Verify that the pump rotation matches the direction indicated on the rotation sticker on top of the pump.

**NOTE:** If the rotation is incorrect, stop the test and disconnect power to the unit. Open the electrical enclosure and switch any two of the three power source wires on the terminal block. Return to Step 2 and check rotation again.

**4 Replace the drip cover and top access panel.**

**5 Press the RUN key to start the unit.**

If everything is working correctly:

- ◆ The RUN/STOP light turns green.
- ◆ The unit initiates a 60-second venting sequence. Cooling and venting valves are active for 60 seconds. The pump is active for the final 30 seconds. Indicator lights will energize when the device is active.
- ◆ Normal operation begins. The heater turns on if the actual temperature is below setpoint. The cooling valve is active if the actual temperature is above setpoint.

The test is over. Proceed to initial setup if the unit operated normally; refer to the *TROUBLESHOOTING* section if it did not.

# INITIAL SETUP



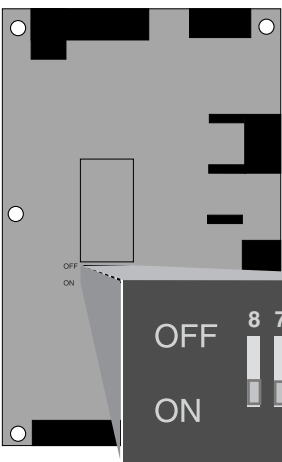
## WARNING: Electric shock hazard

This equipment is powered by high voltage. Always disconnect and lock out the main power source before opening the unit or the electrical enclosure to modify factory settings. Failure to disconnect and lock out the main power source can result in severe personal injury.

The factory-set parameters and operating modes will satisfy most applications. But you can change some settings and enable or disable features as needed.

You can modify the parameters for high and low process temperature deviation warnings from the control panel. See **SETTING SETPOINT DEVIATION PARAMETERS.**

Dip switches on the motherboard inside the TW-1 and TW-2 electrical enclosure allow you to:



- ☐ Select the units of measure for temperature displays.
- ☐ Enable password protection.
- ☐ Enable the Auto Tune.
- ☐ Enable the Auto Start feature.
- ☐ Enable the Test Mode.
- ☐ Select the source point of temperature control.

**NOTE:** All dip switch illustrations in this manual show switches 7 and 8 set to ON. If you have an Isolated Circuit model, these switches should be set to OFF. Do not change the factory settings of these dip switches.

Dipswitch Configuration		
No.	OFF	ON
1	Display units in °F	Display units °C
2	Auto Tune disabled	Auto Tune enabled
3	Passcode protect	Password reset/modify
4 *	Auto Start disabled	Auto Start enabled
5 *	Control point protect	Control point source select
6	Test Mode disabled	Test mode enabled
7 †	Controller type selection	Controller type selection
8 †	Controller type selection	Controller type selection
* Available only on TW-2 models. † Switches 7 and 8 must be ON for Direct Injection and Closed Circuit models. Switches 7 and 8 must be OFF for Isolated Circuit models. Do not change these settings.		

To change the dip switch settings, see the appropriate topic on the following pages.



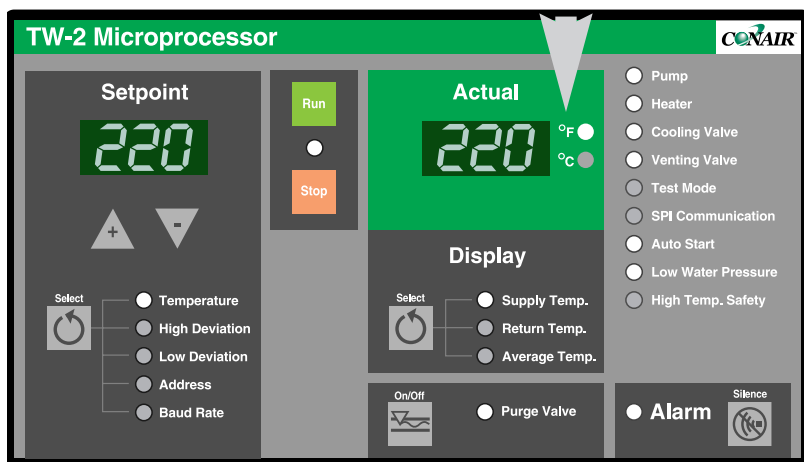
## WARNING: Electric shock hazard

This equipment is powered by high voltage. Always disconnect and lock out the main power source before opening the unit or the electrical enclosure to modify factory settings. Failure to disconnect and lock out the main power source can result in severe personal injury.

# CHANGING TEMPERATURE UNITS

The temperature units are factory-set as degrees Celsius or degrees Fahrenheit, as specified when the unit was ordered.

When the Thermolator is on, the indicator lights to the right of the Actual temperature display on the control panel will show which temperature unit has been set.



To change this setting, move Dip Switch 1 on the control circuit board.

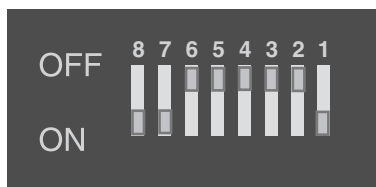
**1** Disconnect and lock out main power to the Thermolator.

**2** Open the electrical enclosure.

**3** Change Dip Switch 1 to:  
OFF for °F



ON for °C



**NOTE:** All dip switch illustrations in this manual show switches 7 and 8 set to ON. If you have an Isolated Circuit model, these switches should be set to OFF.

**4** Close the electrical enclosure and restore main power to begin operating.



# ENABLING AND DISABLING PASSCODE PROTECTION



## WARNING: Electric shock hazard

This equipment is powered by high voltage. Always disconnect and lock out the main power source before opening the unit or the electrical enclosure to modify factory settings. Failure to disconnect and lock out the main power source can result in severe personal injury.

The TW-1 and TW-2 Thermolators provide the ability to protect system parameters from unauthorized changes during normal operating mode. When system passcode protection is enabled, the following parameters cannot be changed unless you enter the correct passcode:

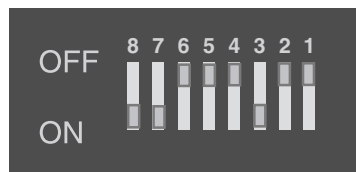
- The Process Setpoint
- High Deviation Alarm Setpoint
- Low Deviation Alarm Setpoint
- Baud Rate selection for serial communications
- Address selection for serial communications

When the unit is turned on for the first time, passcode protection is disabled. To enable passcode protection:

**1** Disconnect and lock out main power to the unit.

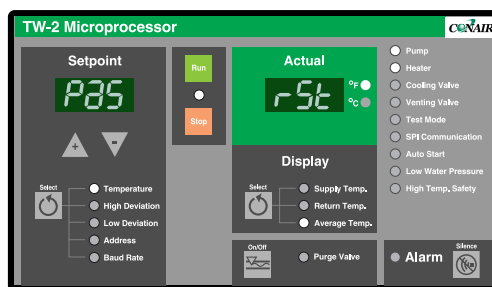
**2** Open the electrical enclosure.

**3** Set dip switch 3 to ON and switches 5 and 6 to OFF.



**4** Close the electrical enclosure and restore power to the unit.

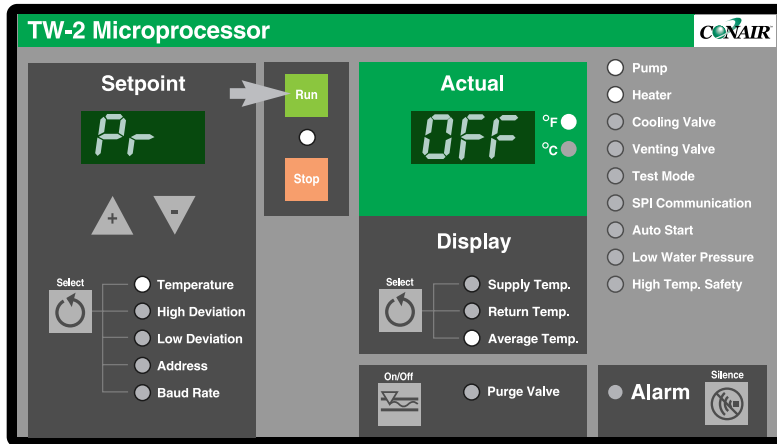
**5** Press any button when the control displays “Pas rSt” (Passcode Reset). The control will display the last passcode used.



**6** Select a new passcode using the ▲ and ▼ setpoint adjustment buttons.

Stop pressing the setpoint buttons when the passcode you want appears in the setpoint display window. Selecting “OFF” as the passcode will disable the passcode feature.

**NOTE:** All dip switch illustrations in this manual show switches 7 and 8 set to ON. If you have an Isolated Circuit model, these switches should be set to OFF.



## ENABLING AND DISABLING PASSCODE PROTECTION

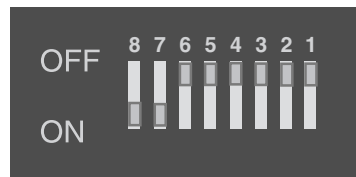
- 7 Press the RUN button to save the passcode.**
  - ◆ The control will display “Pr OFF” to prompt you to remove power to the unit.

**IMPORTANT:** If RUN is not pressed, the new passcode will not be saved.

- 8 Turn off power to the unit.** Disconnect and lock out the main power supply.

- 9 Open the electrical enclosure.**

- 10 Set dip switch 3 to OFF.**



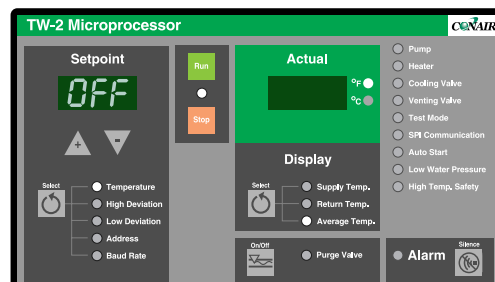
- 11 Close the electrical enclosure and restore power to the unit.**

A passcode now is required to change system parameters.

### Disabling Passcode Protection

To disable passcode protection and allow universal access to system parameters:

- 1 Follow Steps 1 through 5 in the previous section on enabling passcode protection.**
- 2 Hold down the ▼ setpoint adjustment button to select “OFF” as the new passcode.**
- 3 Follow steps 7 through 11 in the previous section.**



# SELECTING THE TEMPERATURE CONTROL POINT

(TW-2 ONLY)



## WARNING: Electric shock hazard

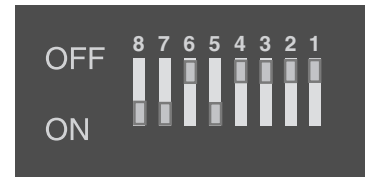
This equipment is powered by high voltage. Always disconnect and lock out the main power source before opening the unit or the electrical enclosure to modify factory settings. Failure to disconnect and lock out the main power source can result in severe personal injury.

TW-1 models control the process temperature based upon the average of the temperatures recorded at the supply (to process) and return (from process) thermocouples.

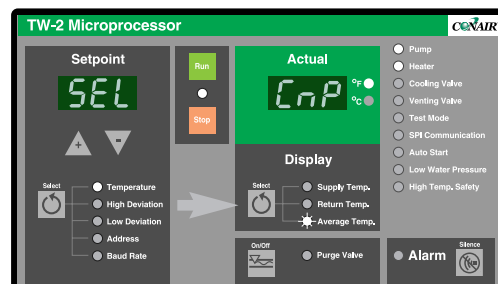
TW-2 models allow you to select how the unit will measure and control the process temperature. The control point can be selected as the supply, the return or the average of the the two temperatures.

To select the control point source on TW-2 models:

- 1 Disconnect and lockout power to the unit.**
- 2 Open the electrical enclosure.**
- 3 Set dip switches 3 and 6 to the OFF position.**
- 4 Set dip switch 5 to the ON position.**
- 5 Close the electrical enclosure and restore power to the unit.**
- 6 Press any button when the control displays “Cnt Pt”.**



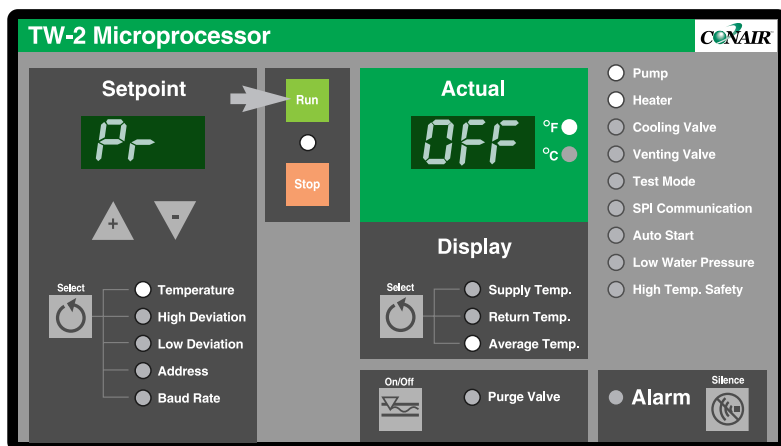
The controller will display “Sel CnP” and flashes the LED for the current control point.



- 7 Select a new control point using the Display button.**

Stop pressing the select button until the indicator light next to the control point you want illuminates.

**NOTE:** All dip switch illustrations in this manual show switches 7 and 8 set to ON. If you have an Isolated Circuit model, these switches should be set to OFF.



## SELECTING THE TEMPERATURE CONTROL POINT (TW-2 ONLY)

### 8 Press the RUN button to save the control point.

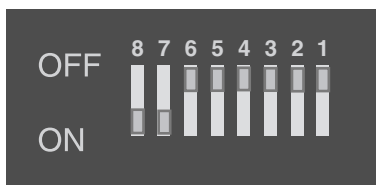
- ◆ The control will display “Pr OFF” to prompt you to remove power to the unit.

**IMPORTANT:** If RUN is not pressed, the new control point source will not be saved.

### 9 Turn off power to the unit. Disconnect and lock out the main power supply.

### 10 Open the electrical enclosure.

### 11 Set dip switch 5 to OFF.



### 12 Close the electrical enclosure and restore power to the unit.

The Thermolator will now control the process temperature based on actual temperatures recorded at the new control point source.

# ENTERING SETPOINT DEVIATION PARAMETERS

You can establish a normal operating range around the process temperature setpoint using the high and low deviation parameters. If the process temperature exceeds the high deviation limit, or falls below the low deviation limit for longer than 15 minutes, the Thermolator will alert you to the unacceptable temperature variation with an alarm light.

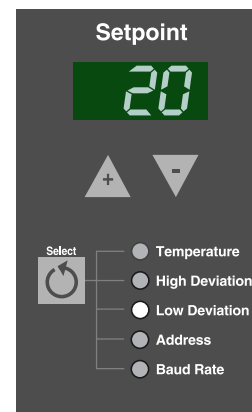
These temperature deviation limits will adjust automatically relative to the process temperature setpoint.

The factory default setting is the process temperature setpoint  $\pm 25^{\circ}\text{F}$  ( $4^{\circ}\text{C}$ ). This parameter is adjustable to establish a narrower or wider acceptable temperature range for normal operation. The Low Deviation cannot be set to fall below the factory-set Low Safety temperature. The High Deviation cannot be set to exceed the factory-set High Safety temperature.

FACTORY DEFAULT SETTINGS		
Model	DI and CC	IC
Process Setpoint	100° F (38° C)	100° F (38° C)
High Safety	260° F (127° C)	190° F (88° C)
Low Safety	22° F (-6° C)	22° F (-6° C)

To change the temperature deviation settings:

- 1 Press the Setpoint Select button to select the deviation parameter you want to change.**
- 2 Use the ▲ and ▼ setpoint buttons to enter the deviation temperature.** The setting is stored in memory even when the power is turned off. The recommended setting is  $\pm 2\text{-}10^{\circ}\text{F}$ .



**NOTE:** If you enabled passcode protection, you must enter the passcode to change this parameter. Too enter the passcode:

Hold down the Setpoint Select button for 5 seconds. When the control displays “1 PaS”, use the setpoint adjustment buttons to enter the passcode. Press the Setpoint Select button again. If the correct passcode was entered the controller will display ACC PAS for 3 seconds. If the passcode was incorrect, the controller will display rEJ PAS (rejected passcode).

Access to system parameters remain until power is cycled or the RUN or STOP button is pressed.

TW-1 and TW-2 Thermolators provide SPI compatible support for RS-485 serial communications with a host machine. You can use SPI communication to change or monitor the:

- Process temperature setpoint
- High and low temperature deviation alarms
- Process status (run and alarm conditions)
- Machine 1 status
- Machine 2 status
- Actual temperature to process
- Actual temperature from process

To use the SPI communication option, you must connect the Thermolator to the host machine and set the communication baud rate and node address using the setpoint select and adjustment buttons on the control panel.

## ACTIVATING SPI COMMUNICATION

**NOTE:** To disable SPI, use the setpoint ▲ or ▼ arrow to select Address. Press the ▼ arrow until OFF is displayed in the setpoint window.

See the [APPENDIX](#) for additional SPI programming information.

### 1 Connect the host machine to the unit.

Plug the male DB9 connector into the serial communications port on the Thermolator.

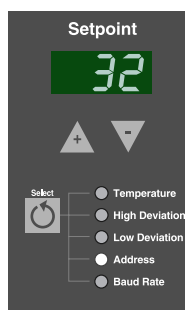
### 2 Apply power to the Thermolator.

### 3 Enter the passcode, if necessary.

Hold the Setpoint Select button for 5 seconds. When the control displays 1 PaS, use the setpoint adjustment buttons to enter the passcode.

### 4 Enter the node address.

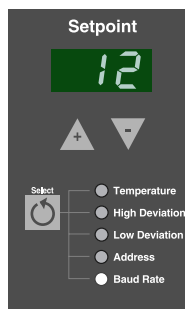
Press the Setpoint Select button to choose Address. Then press the setpoint ▲ or ▼ arrow until the address you want appears in the setpoint display. The address may be set to any number from 32 to 254 (a hexadecimal integer between 20 and FE), as long as that number has not been assigned to another machine connected to the same network.



### 5 Set the baud rate to 12, 24, 48 or 96.

The Thermolator must be set to send and receive data at the same baud rate as the host machine. Press the setpoint ▲ or ▼ arrow until the baud rate you want appears in the setpoint display window.

12 = 1200 bps      48 = 4800 bps  
24 = 2400 bps      96 = 9600 bps



The green SPI status light on the control panel should flash when the unit is communicating. The LED will turn red, indicating an alarm, if SPI communication is not properly set up.

# INSTALLING THE AUTO START FEATURE

(TW-2 ONLY)



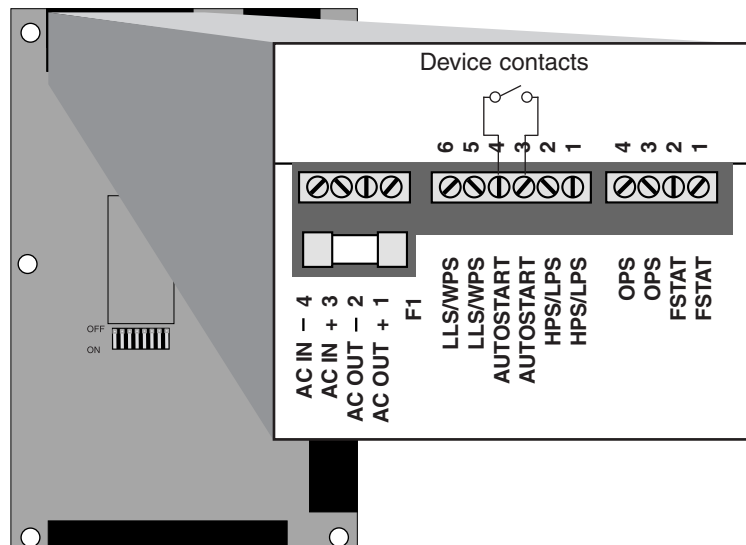
## WARNING: Electric shock hazard

This equipment is powered by high voltage. Always disconnect and lock out the main power source before opening the unit or the electrical enclosure to modify factory settings. Failure to disconnect and lock out the main power source can result in severe personal injury.

If you have a TW-2 model, you can automatically start and stop the Thermolator from a remote switching or timing device that has power contacts rated 110VAC, such as the process machine control.

Wiring the device to the Thermolator is accomplished through a dry contact to the appropriate terminals on the motherboard. After wiring the device to the unit, Auto Start must be enabled by configuring a dip switch on the motherboard.

- 1 Disconnect and lockout power to the unit.**
- 2 Open the electrical enclosure.**
- 3 Punch a small hole in the left side of the electrical enclosure.** The hole must be large enough to accommodate conduit for the power contact wires from your switching or timing device.
- 4 Insert the two power leads from the device** through the conduit into the electrical enclosure.

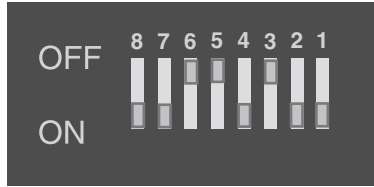


**IMPORTANT:** Always refer to the wiring diagrams that came with your temperature control unit before making electrical connections. The diagrams show the most accurate electrical component information.

- 5 Connect the 110VAC device contact wires to the Auto Start terminals.** Make sure terminals are screwed tight.

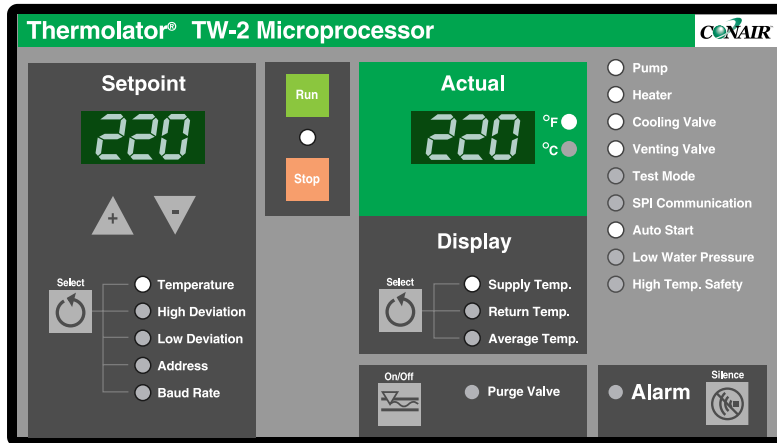
**6** Set dip switch 4 to the ON position.

**7** Close the electrical enclosure and restore power to the unit.



## INSTALLING THE AUTO START FEATURE

(TW-2 ONLY)



**NOTE:** All dip switch illustrations in this manual show switches 7 and 8 set to ON. If you have an Isolated Circuit model, these switches should be set to OFF.

### When Auto Start is enabled:

- ◆ The Auto Start indicator light flashes to indicate that the Thermolator can start at any time. The Thermolator will start whenever the remote switching or timing device sends a signal to start processing.
- ◆ The Auto Start indicator light is on whenever the Thermolator is under the control of the remote device.

### To disable Auto Start:

Repeat steps 1,2 and 7, setting dip switch 4 to the OFF instead of the ON position.





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## OPERATION

- *TW-1 control . . . . .4-2*
- *TW-2 control . . . . .4-3*
- *Mounting the TW-2 control  
in a remote location . . . . .4-4*
- *Entering a passcode . . . . .4-5*
- *Starting the Thermolator . . . . .4-6*
- *Stopping the Thermolator . . . . .4-7*
- *Using the manual purge  
option . . . . .4-8*
- *Using the TW-2 purge feature . .4-9*
- *Performing an Auto Tune . . . . .4-10*

# TW-1 CONTROL

All normal operating functions can be controlled from the TW-1 control panel. If you have the optional manual mold purge, the control button is located on the side of the Thermolator electrical enclosure.

## Setpoint display

The Setpoint display shows the setpoints entered for fluid temperature, high and low temperature deviation alarms, the SPI baud rate, and the SPI address.

Setpoint and Actual value display windows also display some alarm codes and setup instructions.

## Run/Stop

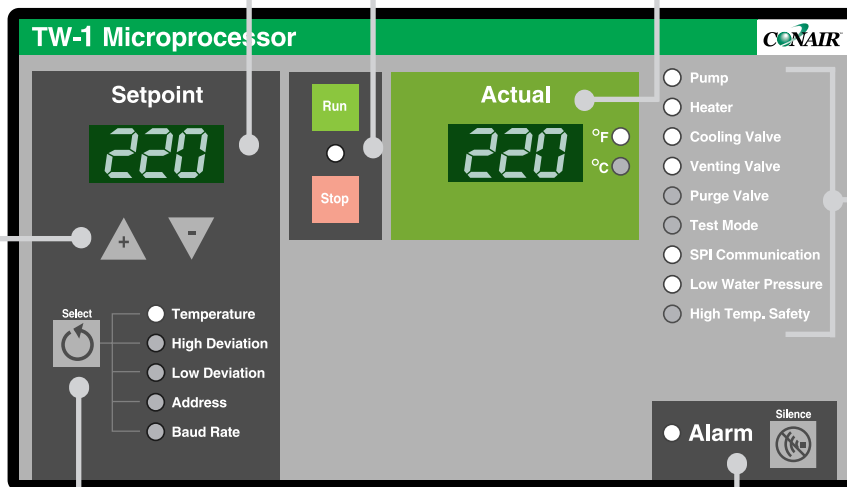
Press RUN button to start normal operation. Press STOP to stop the temperature control unit.

- = Running (green)
- = Stopped (red)
- = Alarm (red, flashing)

## Actual values display

The green window displays the temperature at the middle of the mold. This temperature is calculated as an average of the temperatures of the supply water and return water.

The lights indicate whether the temperature is in degrees Fahrenheit or Celsius. See the *INSTALLATION* section for instructions on how to change the temperature units.



## Status lights

The lights indicate the operating status of the listed components. Except in Test Mode, the lights indicate:

- = Off or inactive
- = On or active (green)
- = Alarm condition (red)

Test Mode is used for testing displays, keys and input/output functions. When test mode is enabled, normal operation is disabled.

- = Test Mode off
- = Test Mode on (red); unit disabled

## Setpoint Select button

Press repeatedly until a green light appears next to the parameter you want to program or view.

**NOTE:** Default settings for the deviation setpoints are:

High = setpoint + 25° F

Low = setpoint - 25° F

A warning alarm occurs (indicator light red) whenever the actual temperature is outside this setpoint range for more than 15 minutes. Recommended setting: ± 2-10° F.

## Alarm

Press to acknowledge the alarm light and silence the optional audible alarm. The alarm light will flash until the cause of the alarm condition is fixed. See Troubleshooting for alarm descriptions and remedies.

## Setpoint adjustment buttons

Press ▲ or ▼ to enter the process temperature setpoint, SPI parameters and passcodes.

Press ▲ to increase a value.

Press ▼ to decrease a value.

**TIP:** Press and hold the button for faster scrolling speed.

**NOTE:** Passcode protection prevents accidental or unauthorized changes to all operating parameters. If passcode protection has been enabled, you must enter the correct passcode to change the process temperature setpoint.

All normal operating functions can be controlled from the TW-2 control panel, including the optional mold purge.

# TW-2 CONTROL




## Setpoint display

The Setpoint display shows the setpoints entered for fluid temperature, high and low temperature deviation alarms, the SPI baud rate, and the SPI address.

Setpoint and Actual value display windows also display some alarm codes and setup instructions.

## Run/Stop

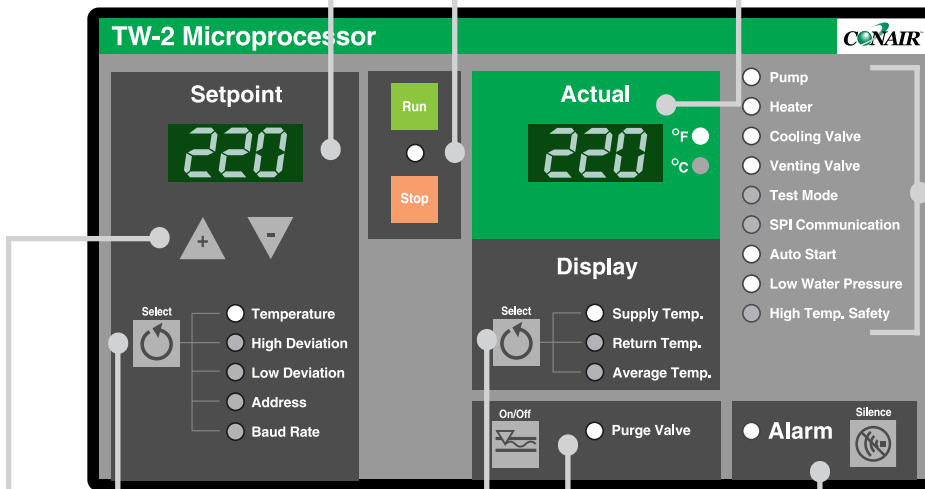
Press RUN button to start normal operation. Press STOP to stop the temperature control unit.

-  Running (green)
-  Stopped (red)
-  Alarm (red, flashing)

## Actual values display




The green window displays the temperature at the middle of the mold. This temperature is calculated as an average of the temperatures of the supply water and return water.

The lights indicate whether the temperature is in degrees Fahrenheit or Celsius. See the *INSTALLATION* section for instructions on how to change the temperature units.





## Status lights




The lights indicate the operating status of the listed components. Except in Test Mode and Auto Start, the lights indicate:

-  = Off or inactive
-  = On or active (green)
-  = Alarm condition (red)

Test Mode is used for testing displays, keys and input/output functions. When test mode is enabled, normal operation is disabled.

-  = Test Mode off
-  = Test Mode on (red); unit disabled

Auto Start allows you to start and stop the TW-2 from a remote switching or timing device, such as the processing machine control. This feature can only be enabled by configuring a dip switch on the control motherboard.

-  = Disabled; Auto Start not available
-  = Enabled (flashing green); unit can start any time
-  = On and under control of the remote device



## Setpoint Select button



Press repeatedly until a green light appears next to the parameter you want to program or view.

**NOTE:** Default settings for the deviation setpoints are:  
High = setpoint + 25° F  
Low = setpoint - 25° F

A warning alarm occurs (indicator light red) whenever the actual temperature is outside this setpoint range for more than 15 minutes.  
Recommended setting:  $\pm 2-10^{\circ}$  F.

## Setpoint adjustment buttons

Press  or  to enter the process temperature setpoint, SPI parameters and passcodes.

Press  to increase a value.  
Press  to decrease a value.



**TIP:** Press and hold the button for faster scrolling speed.

## Alarm

Press to acknowledge the alarm light and silence the optional audible alarm. The alarm light will flash until the cause of the alarm condition is fixed. See Troubleshooting for alarm descriptions and remedies.

## Purge Valve

The light indicates the operating status of the purge valve. Except in Test Mode and Auto Start, the light indicates:

-  = Off or inactive
-  = On or active

## Display Select button

Press repeatedly until a green light appears next to the parameter you want to program or view.

---

## MOUNTING THE TW-2 CONTROL IN A REMOTE LOCATION



**CAUTION:** Improper use of the swiveling control panel can damage the unit.

- **Do not** use the control panel handles or control cables to move the Thermolator. The handles are designed only for orientation of the control panel.
- **Do not** mount the detached TW-2 control panel to a hot surface.

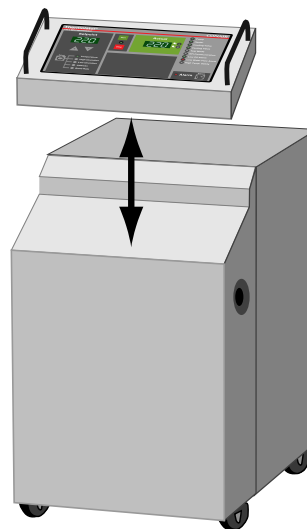
The TW-2 control panel can be mounted up to 50 feet from the unit, using a remote control cable and the magnetic back on the back of the panel.

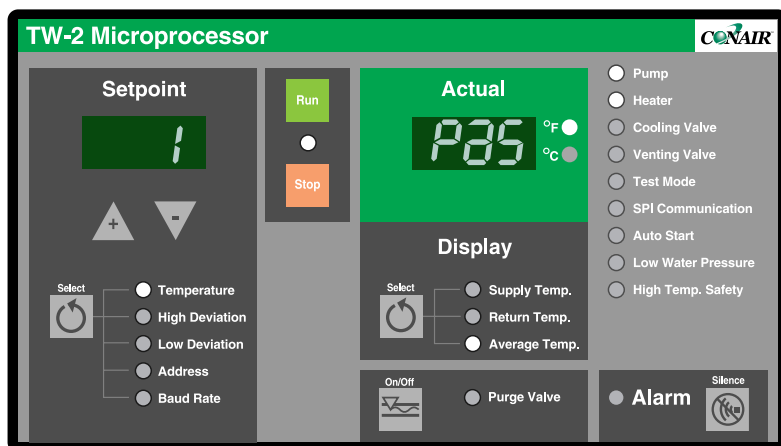
**Do not stretch the cable.** The cable is available in various lengths so that you can order the appropriate cable for your installation.

### To detach the TW-2 control panel:

Grasp the black control panel handles and pull upward.

Use the magnetic back to mount the control panel in the remote location. Connect the remote-mounted control to the unit with the cable provided.









## ENTERING A PASSCODE

TW-1 and TW-2 Thermolators have a security feature that prevents accidental or unauthorized changes to the setpoint temperature, high and low deviation limits, SPI address, and baud rate.

If passcode protection is enabled, you must enter the correct passcode to change these parameters. To enter the passcode:

- 1 Press and hold the Setpoint Select button  for 5 seconds.** The control will display 1 PaS to indicate a passcode is needed.
- 2 Press the Select  button until the correct passcode appears in the display.**
- 3 Press  again to enter the passcode.**  
If the passcode is correct, the control displays ACC PAS for 3 seconds. If the passcode is incorrect, the control displays rEJ PAS (rejected passcode).
- 4 Press Setpoint  to select the parameter you want to change.**

You will have access to the system parameters until:

- The power is cycled off and on.
- The RUN or STOP button is pressed.
- No key has been pressed for 30 seconds.

**NOTE:** Pressing the STOP or RUN key while you are entering a passcode will abort the passcode entry sequence

# STARTING THE THERMOLATOR

**IMPORTANT:** If you are operating the Thermolator for the first time since installation, you should perform an Auto Tune after two hours of normal operation. You should perform the Auto Tune periodically to ensure that the control correctly calculates how much heat and cooling should be applied to maintain the process setpoint. See [“Performing an Auto Tune.”](#)

Before starting the Thermolator, verify that the system has been installed correctly for your application. See the [INSTALLATION](#) section.

If Passcode Protection has been enabled, you must enter the correct passcode before you can change or enter any of the operating parameters, including the temperature setpoint.

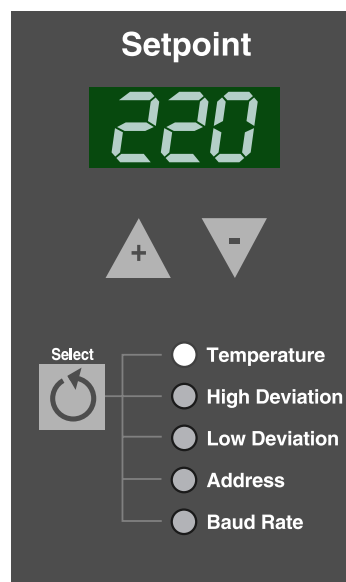
**1 Turn on the water supply to the Thermolator.** The supply must be at least 25 psi. Check for leaks in the cooling water and process fluid lines before continuing.

**2 Turn on main power to the Thermolator.** The control initiates a brief self test.

- ◆ Indicator lights blink green, then red.
- ◆ Setpoint and actual windows will display **8888** for three seconds, followed by the software version. The windows then display the factory default setpoint of 100° F and the actual temperature.

**3 Enter the passcode, if necessary.** Hold the Setpoint Select button for 5 seconds. When the control displays 1 PaS, use the setpoint adjustment buttons to enter the passcode. Press the Setpoint Select button again.

**4 Enter the temperature setpoint.** Press the Setpoint Select button until the green light appears next to Temperature. Press ▲ to increase or ▼ to decrease the temperature setting.



**5 Press **Run** to start normal operation.**

- ◆ The RUN/STOP light turns green.
- ◆ The unit initiates a 60-second venting sequence. Cooling and venting valves are active for 60 seconds. The pump is active for the final 30 seconds.
- ◆ Normal operation begins. The heater turns on when the actual temperature is below setpoint. The cooling valve turns on if the actual temperature is above the setpoint.

If the Alarm light turns on, press  to silence the optional audible alarm. Then see the [TROUBLESHOOTING](#) section.



### **WARNING: Electrical shock and hot surface hazards**

Before attempting maintenance of any kind on the Thermolator, you must stop the unit; disconnect and lockout the main power supply; and allow the unit to cool to less than 100° F (38° C).



## **STOPPING THE THERMOLATOR**

You must shut down the Thermolator whenever you:

- Change the water hookups.
- Shut down the process machine.
- Purge the process circuit of the water or fluid.
- Run the unit's diagnostic tests.
- Perform routine or preventative maintenance.
- See an alarm condition that requires troubleshooting.
- Relocate, ship or store the unit.

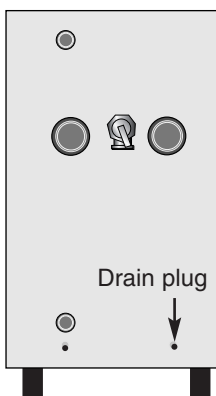
To shut down the unit for purging the process lines, diagnostic testing, routine maintenance or troubleshooting, press the Stop button. Then refer to the appropriate topic or section in this User Guide.

### **To shut down the unit to change water hookups:**

- 1 Press  and drain the unit of all water or fluid.**

Drain the unit using the two drain plugs on the back of the unit.

- 2 Once the unit is cool, remove the water hookups.**



### **To shut down the unit for relocation or storage:**

- 1 Press  and drain the unit of all fluid.**

Drain the unit using the two drain plugs.

- 2 Disconnect the power supply and all water feeds.**

- 3 Position the control panel to rest flush with the unit.**

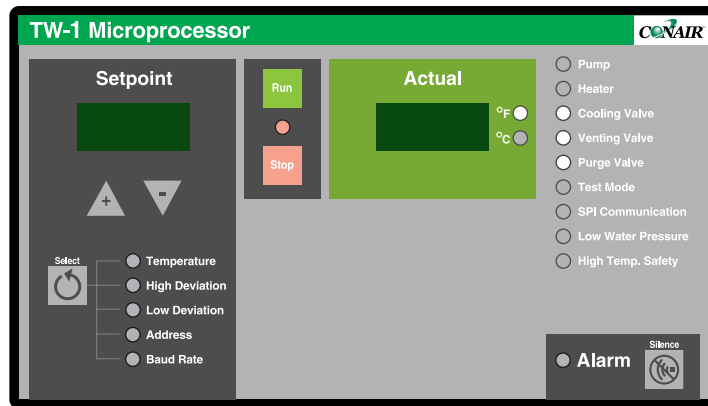
In shipment or storage, the Thermolator can withstand an environment between -40° F (-40° C) and 150° F (65° C) with 95% relative humidity non-condensing.



# USING THE MANUAL PURGE OPTION

TW-1 and TW-2 direct injection and closed circuit models can be ordered with an optional purge valve, which clears the process lines of fluid using compressed air. The valve is operated by a manual purge switch on the side of the unit.

**IMPORTANT:** Before purging the process lines, be sure that the cooling water source feed is closed. If the feed is open and the air line has a higher pressure than the cooling water, air may be injected into the cooling water system. If the cooling water pressure is higher than the air line, cooling water may be injected into the air line.



- 1** Press **Stop** to shut down the Thermolator.
  - ◆ The RUN/STOP LED turns red.
- 2** Turn off the cooling water supply to the unit.
- 3** Press and hold the manual purge switch to start purging.
  - ◆ The Purge Valve LED lights.
  - ◆ The Vent and Cool outputs are activated.
  - ◆ The STOP and RUN buttons are deactivated during the purge or when the cool delay off timer is active.

The time required to clear the process lines of fluid will vary according to the length of the process piping and the size of the tooling.

- 4** Release the purge switch to stop purging.

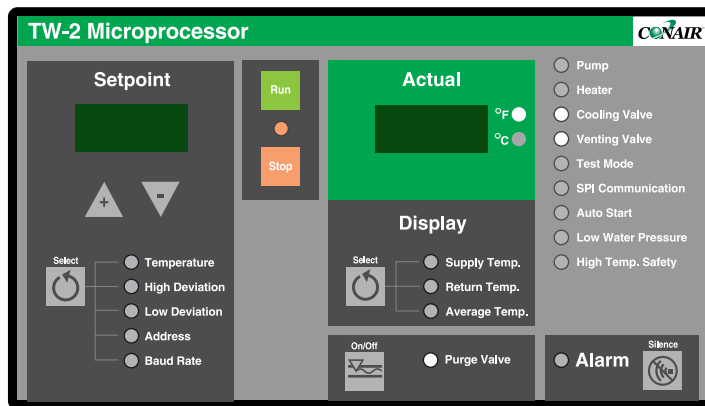
**NOTE:** The purge operation will terminate immediately if the unit detects a blown fuse in the Vent or Cool output. The unit will alarm and shut down.



See the [TROUBLESHOOTING](#) section for instructions on how to clear the alarm and fix the problem.

The TW-2 direct injection models can be ordered with an optional purge valve, which clears the process lines of fluid using compressed air. The valve is operated by a purge button on the control panel.


## USING THE TW-2 PURGE FEATURE

**IMPORTANT:** Before purging the process lines, be sure that the cooling water source feed is closed. If the feed is open and the air line has a higher pressure than the cooling water, air may be injected into the cooling water system. If the cooling water pressure is higher than the air line, cooling water may be injected into the air line.



- 1 Press  to shut down the Thermolator.
  - ◆ The RUN/STOP light turns red.
- 2 Turn off the cooling water supply to the unit.
- 3 Press  to open the valve and start purging.
  - ◆ The Purge Valve LED lights.
  - ◆ The Vent and Cool outputs are activated.
  - ◆ The STOP and RUN buttons are deactivated during the purge or when the cool delay off timer is active.

The time required to clear the process lines of fluid will vary according to the length of the process piping and the size of the tooling.

- 4 Press  to close the valve and stop purging.
  - ◆ The Vent and Cool solenoids remain energized for 5 seconds after the purge is terminated.

**NOTE:** The purge operation will terminate immediately if the unit detects a blown fuse in the Vent or Cool output. The unit will alarm and shut down.

See the [TROUBLESHOOTING section](#) for instructions on how to clear the alarm and fix the problem.



### CAUTION: Gases Under Pressure

Do not disconnect the mold lines until you verify pressure in the cooling water return line is low. Compressed gases can blast liquid at high pressure at the operator, possibly causing serious injury. Check the pressure gauge before disconnecting lines.

# PERFORMING AN AUTO TUNE



## WARNING: Electric shock hazard

This equipment is powered by high voltage. Always disconnect and lock out the main power source before opening the unit or the electrical enclosure to modify factory settings. Failure to disconnect and lock out the main power source can result in severe personal injury.

You should perform an Auto Tune after the first two hours of operation and whenever process variables change (changes in cooling water pressure, piping or molds; large ambient swings; new setpoint temperature) to ensure that the control continues to obtain good approximations of the PID constants used to compensate for the thermal lag of the system.

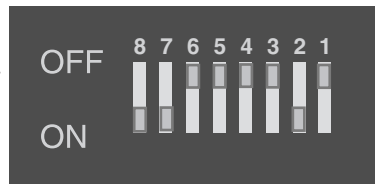
### To ensure a successful Auto Tune, verify that:

- ☐ **The Auto Tune feature has been enabled.** Auto Tune is enabled or disabled via dip switch 2 on the motherboard.
- ☐ **The process value is stable.** A fluctuating process value will fool the software into making inaccurate tuning decisions. The software waits 5 minutes for the process value to stabilize before it starts the Auto Tune process. If the process value still fluctuates after 5 minutes, the Auto Tune terminates and the control displays the “At ti” error.
- ☐ **The control is in STOP mode and the process value is in ambient temperature.** This allows the software to obtain good approximations of process parameters, which are critical for performing an accurate tune. If this requirement is not met, then a good tune cannot be guaranteed.
- ☐ **The setpoint/process deviation is at least 25° F.** If the absolute value of setpoint - process temperature is not greater than or equal to 25° F, the Auto Tune will terminate. The control will display an “At dEV” error.

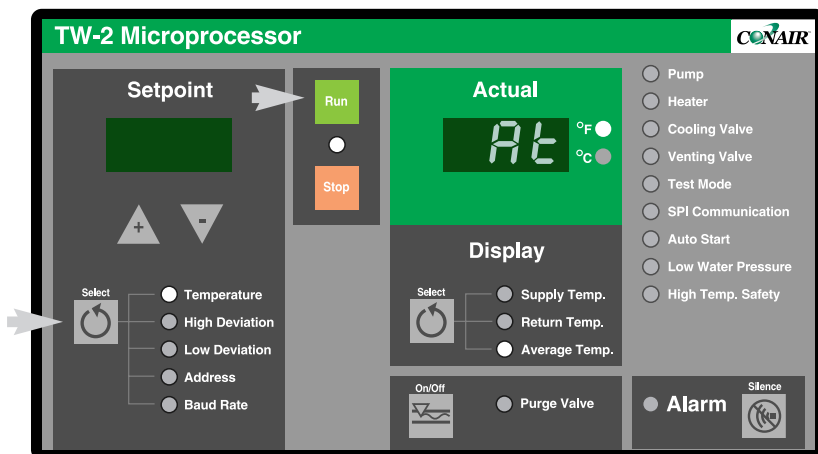
**1** Press  to shut down the Thermolator.

**2** Disconnect and lock out main power to the unit.

**3** **Enable Auto Tune.**  
Open the electrical enclosure.  
Set dip switch 2 to ON.  
Close the electrical enclosure  
and restore power to the unit.



**4** Restore power to the unit.









## PERFORMING AN AUTO TUNE

- 5** Press **Run** and  (the Setpoint Select button) simultaneously to begin the Auto Tune.

The Actual display will flash “At” and the current process temperature to indicate that an Auto Tune is underway.

If Auto Tune is successful, the controller automatically starts controlling using the new PID parameters.

If you press the STOP button or a fault occurs during the Auto Tune, the control enters stop mode and Auto Tuning immediately terminates. The actual display stops flashing “At.” If a fault occurred, the control will display the appropriate error message.

ERROR MESSAGE	ERROR DESCRIPTION
 	<b>Insufficient setpoint/process deviation.</b> If the absolute value of (setpoint - process value) is less than 25° F. The Auto Tune cannot be started until the temperature difference is at least 25° F.
 	<b>Auto Tune timed out.</b> Auto Tune will time out if a stable process value cannot be obtained 5 minutes into the tune, or if the tuning process takes longer than 30 minutes. If this error occurs, verify that you followed every requirement under “To ensure a successful Auto Tune” and perform a second tune.
 	<b>Invalid PID constants were generated.</b> The most likely causes of this error is a tune started inappropriately or an external element (i.e., loose thermocouple) that upset the process while tuning was in progress. Verify that you followed every requirement under “To ensure a successful Auto Tune” and perform a second tune.



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# MAINTENANCE

- *Maintenance schedule . . . . .5-2*
- *Accessing the Thermolator enclosure . . . . .5-3*
- *Checking fluid level in the reservoir (IC models) . . . . .5-4*
- *Performing system tests . . . . .5-5*
- *Key/Display Test . . . . .5-6*
- *Input Test . . . . .5-7*
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- *Calibrating temperature sensors . . . . .5-10*
- *Logging operating hours . . . . .5-12*

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# PREVENTATIVE MAINTENANCE SCHEDULE

Thermolator TW-1 and TW-2 water temperature controllers are essentially maintenance-free. However, to maintain the best performance, we recommend the following maintenance schedule.

## ● Whenever process variables change

### ☐ Perform an Auto Tune.

The Auto Tune ensures that the control continues to obtain good approximations of the PID constants used to compensate for the thermal lag of the system.. You should perform an Auto Tune after the first two hours of operation and whenever the process changes, such as after a mold change; installation of different pipe sizes; or change in process setpoint. [See PERFORMING AN AUTO TUNE](#) in the **OPERATION** section.

## ● Daily

### ☐ Check for leaks in cooling and process lines.

Before and during operation, you should inspect the unit and all plumbing lines for leaks. If a leak develops, stop the Thermolator and repair it.

### ☐ Keep the unit and the area around it clean.

Check for and remove lint, dust or other obstructions on the unit, especially around air intake areas. Keep the floor around the unit dry.

### ☐ Check the process fluid level (IC models).

Isolated circuit models have an internal reservoir that contains the process fluid. Check the level indicator on the back of the unit to make sure the reservoir contains an adequate amount of process fluid. Refill as needed.

## ● Monthly, or as often as needed.

### ☐ Inspect the fluid reservoir (IC models only).

For at least the first three months of operation, check the level switches in the process fluid reservoir for debris or deposits that could interfere with proper operation. Flush and clean the reservoir, if necessary.

## ● Quarterly (every 3 months)

### ☐ Inspect power cords, wires and electrical connections.

Check for loose or frayed wires, burned contacts, and signs of overheated wires. Check exterior power cords to the main power source and from the electrical box to the pump and heating elements. Check the ground wire and thermocouple connections. Replace any wire that appears damaged or has worn or cracked insulation.

---

## PREVENTATIVE MAINTENANCE SCHEDULE

- **Annually (every 12 months)**

- ☐ **Test and calibrate the unit's control systems.**

The Thermolator's Test Mode checks the operation of displays, control buttons, inputs and outputs. You can also calibrate the supply and return thermocouples.

See *PERFORMING SYSTEM TESTS* in this section.



### **WARNING: Electrical shock and hot surface hazards**

Before attempting maintenance of any kind on the Thermolator, you must stop the unit; disconnect and lockout the main power supply; and allow the unit to cool to less than 100° F (38° C)



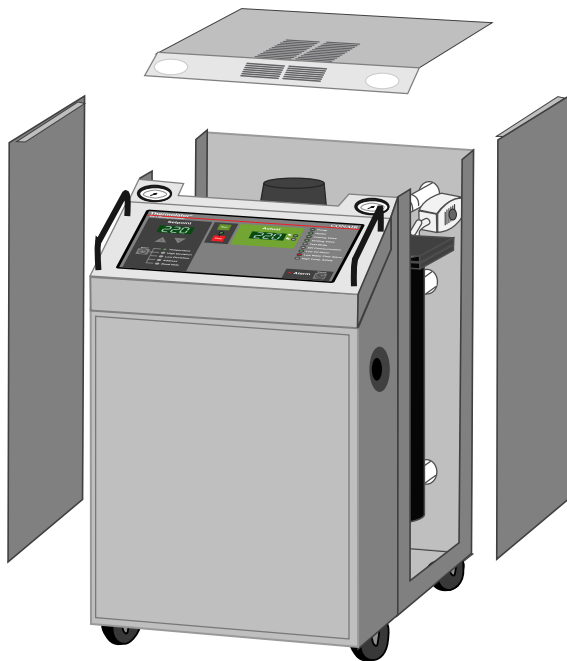
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## ACCESSING THE THERMOLATOR ENCLOSURE

### **To access the Thermolator enclosure:**

Remove the top access panel by lifting straight up.

Remove the side panels by lifting straight up.



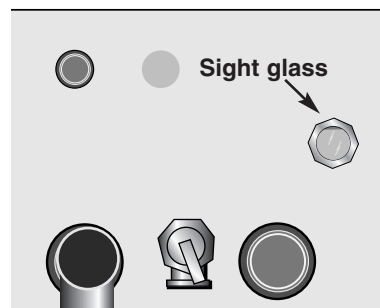


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## CHECKING THE FLUID LEVEL IN THE RESERVOIR (IC MODELS ONLY)

The isolated, or totally closed, circuit models separate the cooling water from the process fluid, which is held in a reservoir inside the unit. This reservoir should be kept at least three-quarters full of the process fluid.

You can check the fluid level in the reservoir using the sight glass on the back of the Thermolator.



To fill the reservoir:

- 1** Disconnect and lockout power, and remove the top panel of the Thermolator.
- 2** Locate the reservoir near the top of the unit.
- 3** Locate the fill port at the top of the reservoir.
- 4** Refill the reservoir. Monitor the level using the sight glass on the back of the unit. Because IC units can use pure water or glycol mixtures, make sure you are adding the correct fluid for your application.

**IMPORTANT:** Do not use deionized water or glycol mixtures containing additives in a Thermolator. Softened water or glycol mixtures with additives, such as automotive fluids, can damage the Thermolator. Glycol/water process loop mixtures should use industrial-grade ethylene glycol only.

- 5** Replace the top panel of the Thermolator.

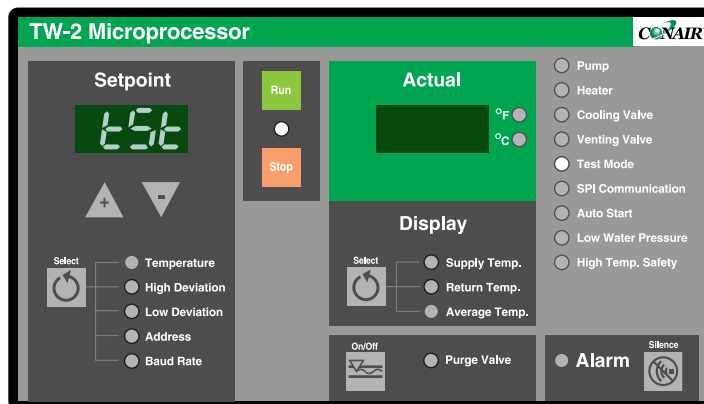
TW-1 and TW-2 Thermolators provide a Test Mode that tests displays and keys on the control panel, as well as inputs and outputs. The Test Mode also allows calibration of the supply and return line thermocouples.

## PERFORMING SYSTEM TESTS

System tests and calibration should be performed annually.


To enable Test Mode:

- 1** Press **Stop** to shut down the Thermolator.
- 2** Disconnect and lock out main power to the unit, then open the electrical enclosure.
- 3** Set dip switches 3 and 5 to OFF.
- 4** Set dip switch 6 to ON.
- 5** Close the electrical enclosure and restore power to the unit.



- ◆ The control displays “tSt.”
- ◆ The Test Mode LED lights.

- 6** Press any button to display the first test menu.  
Test mode provides the following menus:
  - Key/Display Test
  - Input Test
  - Output Test
  - Calibration
  - Total Operating Hours
  - Output Monitor Enable/Disable

- 7** After performing each test, hold the Setpoint  for 3 seconds to index to the next test menu.  
The procedure for each test is described on the following pages.

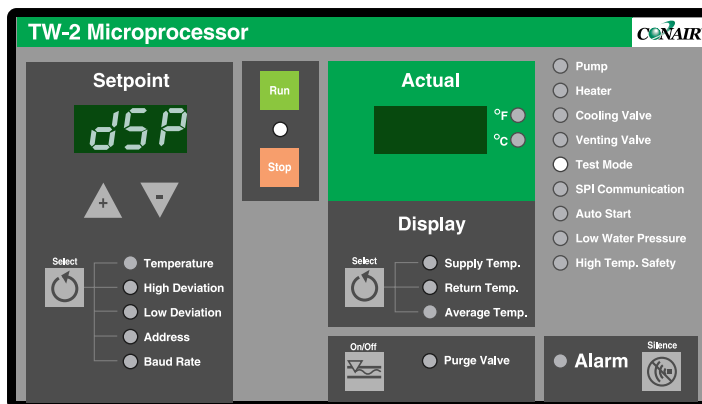
**IMPORTANT:** All normal operating functions are disabled while Test Mode is enabled. To return to normal operation, you must disable Test Mode.

**To disable Test Mode,** repeat steps 2 through 5, setting dip switch 6 to OFF instead of ON.

# KEY/DISPLAY TEST

The Key/Display Test verifies the function of displays, LEDs and buttons on the control panel.


- 1 Enable Test Mode.**
- 2 Press any key.**
- 3 If necessary, index to the Key/Display menu.**



Press and hold the Setpoint  key for 3 seconds to index to each test menu until the controller displays “dSP”.

- 4 Press any key to clear all displays.**
- 5 Repeatedly press any key to test displays.**

With each key press, a new segment of all six 8-segment LEDs and a select group of LED indicator lights will illuminate.
- 6 Exit the test and enter the next test.**

Press and hold the Setpoint  key for 5 seconds to exit and index to the next test.

# INPUT TEST

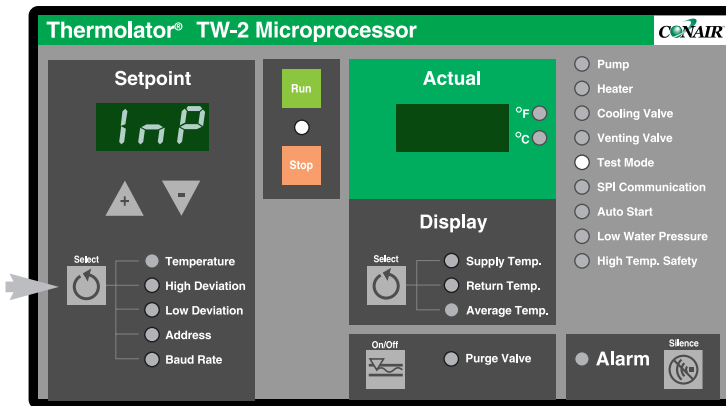
The Input Test verifies the function of inputs available on the various TW-1 and TW-2 models. Not all inputs are used on all models. The performance evaluation of the inputs is based on the voltage sensing device (VSD).

**1 Connect all inputs to the system.**

**2 Press any key to display the first test menus.**

**3 Select the Input Test menu.**

Press and hold the Setpoint  key for 3 seconds to index to each test menu until the controller displays “InP”.



**4 Repeatedly press and release any key to test.**

With each key press and release, the left display will indicate the number of the input being tested (v1, v2, v3, etc.). The right display indicates either “1” for voltage present or “0” for an absence of voltage.

Only inputs that are actually used by the particular model will be tested.

**5 Exit the test and enter the next test.**

Press and hold the Setpoint  key for 3 seconds to exit and index to the next test.

# OUTPUT TEST

The Output Test verifies the function of outputs available on the various TW-1 and TW-2 models. Not all outputs are used on all models. The performance evaluation of the inputs is based on the output monitors (OM).

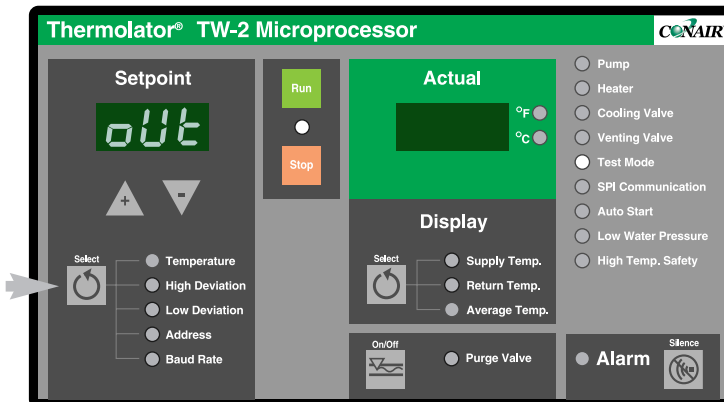
## 1 Connect all outputs to the system.

**IMPORTANT:** Testing each output requires the firing of the associated solid state relay. Make sure an output device is connected to the controller, otherwise the test result will be erroneous.

## 2 Enable Test Mode.

## 3 Press any key to display the first test menus.

## 4 Select the Output Test menu.



Press and hold the Setpoint  key for 3 seconds to index to each test menu until the controller displays “oUt”.

## 5 Repeatedly press and release any key to test.

With each key press and release, the left display will indicate the number of the output being tested (oS1= OM1; oS2 = OM2; etc.). The right display indicates either “1” for a good output or “O” for a failed output.

Only outputs that are actually used by the particular model will be tested.

## 6 Exit the test and enter the next test.

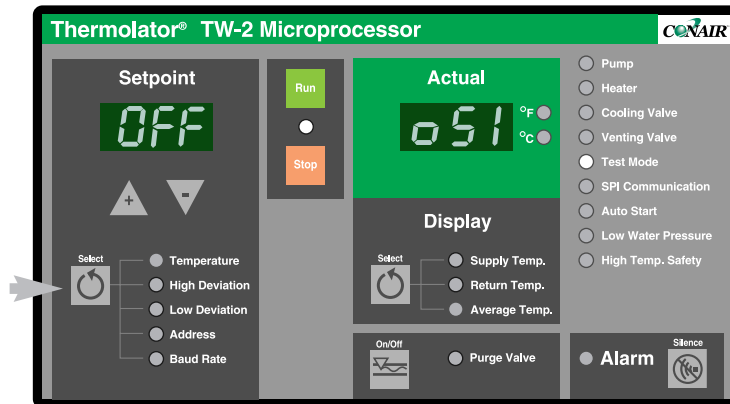
Press and hold the Setpoint  key for 3 seconds to exit and index to the next test.


All output monitors on the Thermolator can be enabled or disabled permanently through the OM Enable/Disable Menu in Test Mode.

You need to use this feature if you have replaced the motherboard, or if dip switches 7 and 8 have been changed erroneously. This will enable any required output monitors that were disabled and give fuse failures.



## DISABLING OR ENABLING OUTPUT MONITORS

- 1 Enable Test Mode.**
- 2 Press any key to display the first test menus.**



- 3 Select the OM Enable/Disable menu.**  
Press and hold the Setpoint  key for 3 seconds to index to each test menu until the controller indicates “oS1” in the actual display and the status of the selected output in the Select display.
- 4 Press the Setpoint ▲ or ▼ key to change the status.** Each press of the key changes the output status from ON to OFF or OFF to ON.

OUTPUT MONITOR SELECTION GUIDE			
MODEL TYPE	DI	CC	IC (TCC)
OM1 Pump	ON	ON	ON
OM2 Heat	ON	ON	ON
OM3 Cool	ON	ON	ON
OM4 Vent	OFF	ON	OFF
OM5 Purge (TW-2 option only)	ON	ON	OFF

- 5 Press the Setpoint  to select the next output.**  
Repeat Step 4 to change the status of the output, or press any key to continue indexing through the outputs.
- 6 Save changes and exit the output menu.**  
Press and hold the Select  key for 3 seconds to save the changes and exit.

# CALIBRATING TEMPERATURE SENSORS

## Special Tools Needed:

☐ type K thermocouple calibrator

TW-1 and TW-2 Thermolators use type “K” thermocouples to sense the temperature in the return and supply process lines. These thermocouples should be calibrated annually, or when a new thermocouple is installed, to ensure correct operation.

The Thermolator’s Calibration Mode provides zero and span calibration of both the supply and return line thermocouples. You access the Calibration Mode while in Test Mode.

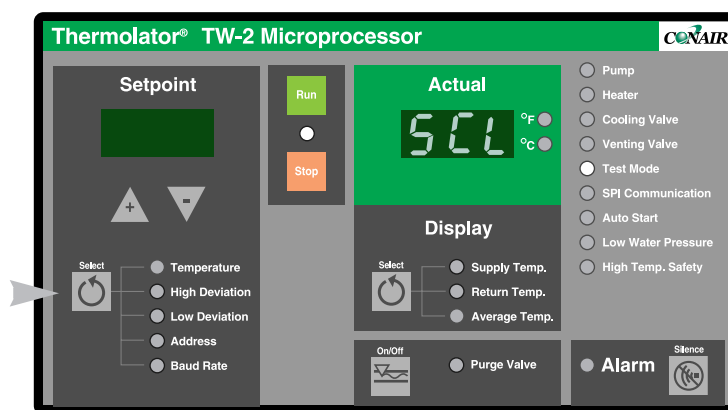
### 1 Enable Test Mode.

See [PERFORMING SYSTEM TESTS](#).

### 2 Press any button to display the first test menu.

### 3 Select the Calibration Mode menu.

Press and hold the Setpoint  key for 3 seconds to index to each test menu until the controller indicates “SC.L” in the Actual display.



### 4 Release the Setpoint key.

You are now in calibration mode. Each press and release of this key will exit the current calibration and start the next calibration. The table below lists the calibrations that will be performed.

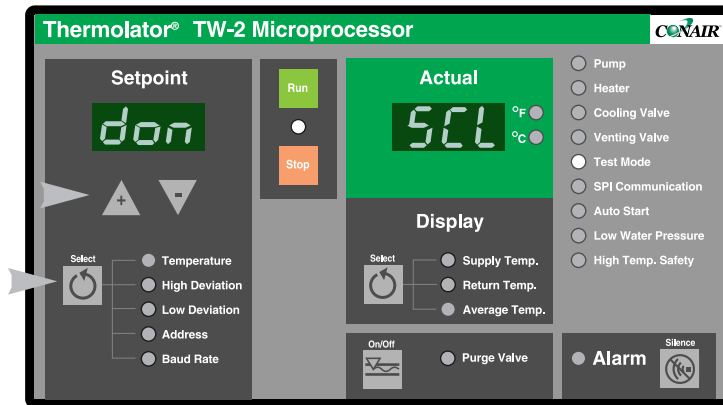
CALIBRATION	SETPOINT DISPLAY	ACTUAL DISPLAY
Zero Calibrate Supply Sensor	32° F (0° C)	SC.L
Zero Calibrate Return Sensor	32° F (0° C)	rC.L
Span Calibrate Supply Sensor	510° F (266° C)	SC.H
Span Calibrate Return Sensor	510° F (266° C)	rC.H

### 5 Using the thermocouple calibrator, apply the appropriate temperature to the control input.

# CALIBRATING TEMPERATURE SENSORS

## 6 Press the up ▲ key to begin calibrating.

The controller displays the name of the current calibration (examples: 32 SC.L; 32 rC.L; 510 SC.H; or 510 rC.H).




## 7 Wait until the control displays “don” or “bad.”

A “don” message in the Setpoint display indicates the calibration was successful. A “bad” message in the Setpoint display indicates a bad calibration.

**NOTE:** The original calibration value stored in EEPROM can be restored for the current calibration by pressing the STOP key at any time.

## 8 Press Select to start the next calibration.

Pressing and releasing the Select  key at the end of a calibration tells the controller to perform the next calibration.

## 9 Exit Calibration Mode.

Press and hold the Select  key for 3 seconds to exit the Calibration Mode.

You can now proceed to the next test in Test Mode, or disable Test Mode and resume normal operation.

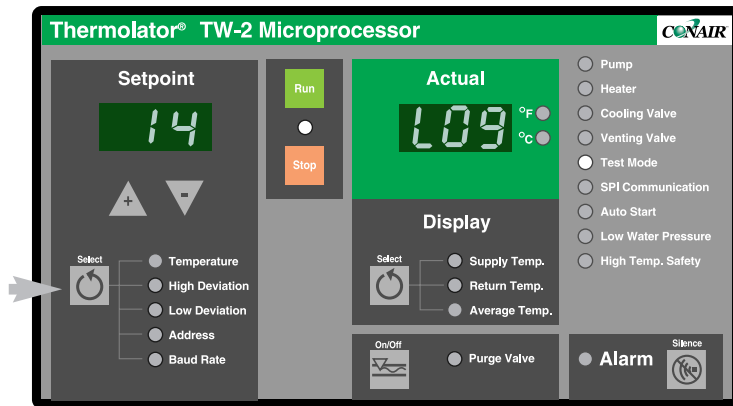
**TO DISABLE TEST MODE,** complete steps 2 through 5 in “Performing System Tests”, setting dip switch 6 to OFF instead of ON.





# LOGGING OPERATING HOURS

You can see the total numbers of operation by accessing the Total Operating Hours Log in Test Mode.

- 1 Enable Test Mode.**
- 2 Press any key to display the first test menus.**



- 3 Index through test menus to the operating log.**  
Press and hold the Setpoint  key for 3 seconds to index to each test menu until the Actual display indicates "Log". The Setpoint display indicates the total number of operating hours in 100-hour units.
- 4 Exit the Operating Hours Log.**  
Press and hold the Select  key for 3 seconds to exit and index to the next test.

You can now proceed to another menu in Test Mode, or disable Test Mode and resume normal operation.

**TO DISABLE TEST MODE**, complete steps 2 through 5 in "[Performing System Tests](#)", setting dip switch 6 to OFF instead of ON.

# TROUBLESHOOTING

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## BEFORE BEGINNING

You can avoid most problems by following the recommended installation, operation and maintenance procedures outlined in this User Guide. If you do have a problem, this section will help you determine what caused it and tell you how to fix it.

### Before you begin troubleshooting:

- ❑ **Find the wiring, plumbing and other diagrams that were shipped with your equipment.** These diagrams are the best reference for correcting a problem. The diagrams also will note any custom features, such as special wiring, control or plumbing options, not covered in this User Guide.
- ❑ **Verify that you have manuals for other equipment in the process line.** Solving problems may require troubleshooting malfunctions or incorrect operating procedures on other pieces of equipment.
- ❑ **If an alarm is present, note any indicator lights and messages shown on the control panel.** These indicators will help you discover the cause of the problem more quickly.

---

## A FEW WORDS OF CAUTION

The Thermolator is equipped with many safety devices. Do not remove or defeat them. Improper corrective action can lead to hazardous conditions, and should never be attempted to sustain production.



**WARNING:** This machines should be adjusted and serviced only by qualified technical personnel who are familiar with construction and operation of this type of equipment.



**WARNING: Hot surfaces and liquids**

Allow the Thermolator to cool to below 100° F (38° C) before servicing the unit.



**DANGER: Voltage hazard.**

Troubleshooting the electrical system of this equipment requires use of precision electronic measuring equipment, and may require access to the electrical enclosure while power is on. Exposure to potentially fatal voltage levels may be unavoidable. These troubleshooting procedures should be performed only by qualified electrical technicians who know how to use this precision electronic equipment and who understand the hazards involved.

Most Thermolator malfunctions are indicated by an illuminated alarm light and error codes displayed on the control panel.



### A problem can trigger three types of alarms:

- **Shut Down Alarms:** The Thermolator detected a problem that caused it to shut down automatically to prevent equipment damage or personal injury.
- **Warning Alarms:** The Thermolator continues to operate, but warns of a problem that could lead to a condition that will shut down the unit.
- **System Errors:** The system error codes indicate a non-recoverable problem with the microprocessor control.


When the Thermolator control detects a problem, the red Alarm light is activated and the RUN/STOP light changes from green to flashing red.



### When an Alarm condition occurs:

- 1** Press  to silence any optional audible alarm.
  - ◆ The RUN/STOP light changes from flashing red to steady red.
- 2** Note any indicator lights or error messages to help determine the cause of the problem.
- 3** Find the alarm or error code in the diagnostics tables in the TROUBLESHOOTING section of this manual.
- 4** Press  to clear the alarm and shut down the Thermolator to correct the problem.


Press  to resume normal operation after the problem is corrected.

 **WARNING:**  
Disconnect and lockout the main power source before opening the Thermolator or its electrical enclosure for servicing. Disconnect air and water supply lines as needed.

# SHUT DOWN ALARMS

The Thermolator has detected a problem that could lead to equipment damage or personal injury if it is not corrected.



- ◆ The Alarm LED lights and the STOP/RUN LED flashes red.
- ◆ The Thermolator automatically shuts down.
- ◆ The control displays a red LED or alarm code indicating the source of the problem.

Alarm	Possible cause	Solution
<p>● <b>Low Water Pressure</b></p> <p><b>The cooling water pressure is less than 25 psi.</b></p> <p><b>Note:</b> The unit will re-start automatically after a two-second delay if the water pressure returns to at least 25 psi.</p>	<p><b>Is the water supply pressure at least 25 psi?</b></p>	<p>Verify that the water supply is on and delivering water at a pressure of at least 25 psi. Check for closed valve or faulty pump in the supply circuit.</p>
	<p><b>Did the pressure switch fail?</b></p>	<p>Watch gauges while turning cooling water on and off. If pressure vents automatically, check vent or cooling valve.</p>
	<p><b>Did the cooling valve fail?</b></p>	<p>Check the cooling valve. <a href="#">See Repairing Solenoid Valves</a> or the Motorized Cooling Valve instructions.</p>
<p>● <b>Pump</b></p> <p><b>The pump motor overload has tripped. The contact is open.</b></p> <p> <b>WARNING:</b> Only qualified electrical service personnel should examine and correct problems that require opening the unit's electrical enclosure or checking electrical current to diagnose the cause of a problem.</p>	<p><b>Is the correct voltage supplied to the pump motor?</b></p>	<p>Supply voltage should match the rating on the pump name plate. If voltage is correct, check wiring connections.</p>
	<p><b>Is the required water flow greater than the pump's capacity?</b></p>	<p><input type="checkbox"/> Review pump sizing for the application.</p> <p><input type="checkbox"/> Decrease the water flow from the process.</p>
	<p><b>Is the motor overload faulty or set incorrectly?</b></p>	<p>Disconnect the power and open the electrical enclosure. Verify that the overload is set to trip at the proper amperage, which should not exceed the FLA. Manually trip and reset the overload. If the problem continues, replace the overload. <a href="#">See Resetting and Replacing Overloads.</a></p>
	<p><b>Is the pump working properly?</b></p>	<p>Replace the pump if supply voltage, wiring and overload settings are correct, but the pump continues to draw excessive current.</p>

The Thermolator has detected a problem that could lead to equipment damage or personal injury if it is not corrected.

- ◆ The Alarm LED lights and the STOP/RUN LED flashes red.
- ◆ The Thermolator automatically shuts down.
- ◆ The control displays a red LED or alarm code indicating the source of the problem.

## SHUT DOWN ALARMS

Alarm	Possible cause	Solution
<p>● <b>High Temp. Safety</b></p> <p>The actual temperature of water supplied to the process exceeds the 260° F safety switch limit.</p> <p> <b>WARNING:</b> Only qualified electrical service personnel should examine and correct problems that require opening the unit's electrical enclosure or checking electrical current to diagnose the cause of a problem.</p>	<p>Has water stopped flowing through the unit or between the supply outlet and return inlet?</p> <p>Is the optional electro-mechanical safety switch improperly set or defective?</p> <p>Has the heater contactor failed?</p>	<p><input type="checkbox"/> Verify that the unit is running and that the pump is working.</p> <p><input type="checkbox"/> Check for closed or defective cooling or vent valves and plugged lines. <a href="#">See Repairing Solenoid Valves.</a></p> <p>Check the switch setting. A too-low setting will cause nuisance trips. Check the switch and replace if defective. <a href="#">See Checking and Replacing Switches.</a></p> <p>Replace the contactor if defective. <a href="#">See Replacing the Heater Contactor.</a></p>
<p><b>Hi</b> <b>SAF</b></p> <p>The actual temperature of water supplied to the process exceeds the programmed 260° F safety limit.</p> <p> <b>WARNING:</b> Only qualified electrical service personnel should examine and correct problems that require opening the unit's electrical enclosure or checking electrical current to diagnose the cause of a problem.</p>	<p>Has water stopped flowing through the unit or between the supply outlet and return inlet?</p> <p>Has the heater contactor failed?</p>	<p><input type="checkbox"/> Verify that the unit is running and that the pump is working.</p> <p><input type="checkbox"/> Check for closed or defective cooling or vent valves and plugged lines. <a href="#">See Repairing Solenoid Valves.</a></p> <p>Replace the contactor if defective. <a href="#">See Replacing the Heater Contactor.</a></p>

# SHUT DOWN ALARMS

The Thermolator has detected a problem that could lead to equipment damage or personal injury if it is not corrected.

- ◆ The Alarm LED lights and the STOP/RUN LED flashes red.
- ◆ The Thermolator automatically shuts down.
- ◆ The control displays a red LED or alarm code indicating the source of the problem.

Alarm	Possible cause	Solution
<div>Lo SAF</div> <p>Actual temperature of water supplied to the process is below the programmed 20° F safety limit.</p>	<p>Is the cooling valve stuck open?</p>	<p>Disassemble the cooling valve and check for particles blocking the valve seat. Check the valve seat for excessive wear. Replace parts as required using a valve repair kit. <a href="#">See Repairing Solenoid Valves.</a></p>
	<p>Has the heater failed?</p>	<p>Check for a bad heating element, or a heater contactor that failed in the open position. <a href="#">See Replacing the Heater Contactor</a> and <a href="#">Replacing Heater Elements.</a></p>
<div>Pbr Err</div> <p>The thermocouple in the process return line failed.</p>	<p>Is the thermocouple loose?</p>	<p>Check for a loose thermocouple or loose wire connections to the thermocouple.</p>
	<p>Has the thermocouple failed?</p>	<p>Check the thermocouple and replace if necessary. <a href="#">See Checking and Replacing Thermocouples.</a></p>
<div>PbS Err</div> <p>The thermocouple in the process supply line failed.</p>	<p>Is the thermocouple loose?</p>	<p>Check for a loose thermocouple or loose wire connections to the thermocouple.</p>
	<p>Has the thermocouple failed?</p>	<p>Check the thermocouple and replace if necessary. <a href="#">See Checking and Replacing Thermocouples.</a></p>

The Thermolator has detected a problem that could lead to equipment damage or personal injury if it is not corrected.

- ◆ The Alarm LED lights and the STOP/RUN LED flashes red.
- ◆ The Thermolator automatically shuts down.
- ◆ The control displays a red LED or alarm code indicating the source of the problem..

## SHUT DOWN ALARMS


Alarm	Possible cause	Solution
<div>PHS Err</div> <p>The incoming power is out of phase. A leg may have failed or is disconnected.</p> <p><b>NOTE:</b> This alarm is available only on TW-2 models.</p>	<p>Is the pump rotating in the wrong direction?</p> <p>Has one of the main supply wire leads become disconnected?</p>	<p>Check pump rotation against the arrow stamped on the pump. If the pump is rotating in the wrong direction, disconnect and lockout the main power source. Open the electrical enclosure, and reverse any two leads on the power connection.</p> <p>Disconnect power and open the electrical enclosure. Check for loose connections in main supply and on motherboard.</p>
<div>FUS 002</div> <p>Pump fuse.</p> <div>FUS 003</div> <p>Heater fuse.</p> <div>FUS 004</div> <p>Cooling valve fuse.</p> <div>FUS 005</div> <p>Vent valve fuse.</p> <div>FUS 006</div> <p>Purge valve fuse.</p>	<p>Has the indicated device blown a fuse?</p> <p>Is the correct device being used for this fuse location?</p> <p>Has the motherboard output channel at the designated fuse failed?</p>	<p>Disconnect and lockout the main power. Open the electrical enclosure. Check for loose wires and incorrectly installed jumpers or terminal blocks associated with the fuse error. Replace the fuse, if necessary. <a href="#">See Checking and Replacing Fuses.</a></p> <p>Replace the fuse, then enter Test Mode. Turn off the Output Monitor associated with the fuse location and test outputs. <a href="#">See Performing System Tests and Disabling or Enabling Output Monitors</a> in the <i>MAINTENANCE</i> section.</p> <p>Replace the motherboard. <a href="#">See Checking and Replacing the Motherboard.</a></p>



# WARNING ALARMS

The Thermolator has detected a problem that could lead to a shut down condition if it is not corrected.


- ◆ The Alarm LED lights.
- ◆ The Thermolator continues operating.
- ◆ The control displays a red LED or alarm code indicating the source of the problem.

Alarm	Possible cause	Solution
<p><b>● Low Deviation</b></p> <p>The Thermolator will not heat to the setpoint temperature, or takes too long to reach the setpoint temperature. The actual temperature of fluid supplied to the process is lower than the setpoint deviation allows.</p> <p> <b>WARNING:</b> The Thermolator should be tested and repaired only by qualified technicians equipped with the correct tools and trained in the maintenance and repair of electrical systems and industrial appliances.</p>	<b>Is the cooling valve stuck open or leaking water?</b>	Disassemble the cooling valve and check for particles blocking the valve seat. Check the valve seat for excessive wear. Replace as required using a valve repair kit. <a href="#">See Repairing Solenoid Valves.</a>
	<b>Did a heater element fail?</b>	<b>With the unit powered down:</b> Check for loose connections. Check resistance between the phase legs on the output side of the heater contactor. Readings should be within 0.25 ohms of each other. Replace the heater, if necessary. <a href="#">See Replacing Heater Elements.</a>
	<b>Did a heater contactor fail?</b>	<b>With power on and the Heater LED lit:</b> Check the amp draw on each of the three phase legs to the heater. All should match the FLA listed for the heater on the unit nameplate. Replace the heater contactor if there is a voltage imbalance greater than 10%. <a href="#">See Replacing the Heater Contactor.</a>
	<b>Is the low deviation temperature set too low?</b>	Increase the low deviation setting. The recommended setting is 2° F to 10° F below the process setpoint.
	<b>Is the Thermolator correctly sized for the application?</b>	Review specifications and selection guidelines that apply to heater and pump sizes in temperature control units.

The Thermolator has detected a problem that could lead to a shut down condition if it is not corrected.

- ◆ The Alarm LED lights.
- ◆ The Thermolator continues operating.
- ◆ The control displays a red LED or alarm code indicating the source of the problem.

## WARNING ALARMS

Alarm	Possible cause	Solution
<div>● <b>High Deviation</b></div> <p>The Thermolator will not cool down, or takes too long to cool down. The actual temperature of fluid supplied to the process is higher than the setpoint deviation allows.</p> <div> <b>WARNING:</b> The Thermolator should be tested and repaired only by qualified technicians equipped with the correct tools and trained in the maintenance and repair of electrical systems and industrial appliances.</div>	<b>Has water stopped flowing between supply outlet and return inlet?</b>	Check for a plugged pipe or closed valve.
	<b>Did the cooling valve fail?</b>	Check the cooling valve. <a href="#">See Repairing Solenoid Valves</a> or the Motorized Cooling Valve instructions.
	<b>Is the temperature difference between the cooling water supply and the setpoint too small?</b>	The temperature difference should be at least 25° F to achieve proper cooling. Increase the process setpoint, decrease the cooling water supply temperature, or increase cooling water supply pressure.
	<b>Did a heater contactor fail?</b>	<b>With power on and the Heater LED lit:</b> Check the amp draw on each of the three phase legs to the heater. All should match the FLA listed for the heater on the unit nameplate. Replace the heater contactor if there is a voltage imbalance greater than 10%. <a href="#">See Replacing the Heater Contactor.</a>
	<b>Is the cooling valve the wrong size?</b>	Check the cooling load (Btu/hr) for which the valve was specified.
	<b>Is the high deviation temperature set too low?</b>	Increase the high deviation setpoint. The recommended setting is the setpoint + 2° F to 10° F.

# WARNING ALARMS

The Thermolator has detected a problem that could lead to a shut down condition if it is not corrected.

- ◆ The Alarm LED lights.
- ◆ The Thermolator continues operating.
- ◆ The control displays a red LED or alarm code indicating the source of the problem.

Alarm	Possible cause	Solution
<b>● SPI Communication</b>  The SPI communication link has failed.	<b>Is the unit connected to a host machine?</b>	If the Thermolator is not connected to a host device, set the SPI address to OFF using the Setpoint adjustment buttons on the control panel.
	<b>Are the network address and baud rate correct?</b>	<input type="checkbox"/> Check the network address. The address may be set to any number from 32 to 254 (a hexadecimal integer between 20 and FE), as long as that number has not been assigned to another machine connected to the same network. <input type="checkbox"/> Make sure the baud rate (9600, 4800, 2400, or 1200) matches the host machine.
	<b>Is something wrong with the cable?</b>	Check the communication cable condition and connections. The cable must conform to SPI standards. Check for loose connections on the motherboard.

The Thermolator has detected a non-recoverable error involving the microprocessor control.

- ◆ The Alarm LED lights and the STOP/RUN LED flashes red.
- ◆ The Thermolator shuts down or will not start.
- ◆ The control displays an error code indicating the source of the problem.

## SYSTEM ALARMS

Alarm	Cause	Solution
<div>ERR 001</div> <b>RAM hardware failure.</b>	Electrical noise or failed CPU on the motherboard caused system write tests to fail during power up.	Make sure all connections on the motherboard are solid. Operate unit in a noise free environment. If error persists, contact Conair service.
<div>ERR 002</div> <b>ROM, checksum failure.</b>	The CPU and/or PROM chip (U1 or U2) is not making good contact with its socket, or the PROM chip has failed.	Make sure the CPU and PROM chips are seated correctly in the sockets. If error persists, contact Conair service.
<div>ERR 003</div> <div>ERR 004</div> <b>COP failures.</b>	A failed CPU, failed motherboard, software bug or electrical noise caused an internal software error.	Cycle power to the unit. If the problem persists, contact Conair service technicians. You may need to replace the motherboard.
<div>ERR 005</div> <b>Illegal Opcode.</b>	The CPU tried to execute an illegal software instruction due to electrical noise or a failed motherboard.	Make sure all connections to the motherboard are solid and that the unit is operating in a noise free environment. If error persists, contact Conair service.
<div>ERR 006</div> <div>through</div> <div>ERR 014</div>	A failed CPU, failed motherboard, software bug or electrical noise caused an internal software error.	Cycle power to the unit. If the problem persists, contact Conair service technicians. You may need to replace the motherboard.
<div>ERR 015</div> <div>ERR 016</div> <b>Software cannot write to CPU non-volatile memory.</b>	The memory has exceeded its usable life or there is a software bug. This error occurs only after changes have been made to non-volatile memory either through the operator panel or SPI.	Cycle power to the unit. Contact Conair service if an operating parameter such as the setpoint is not being saved or if this error persists.

# THERMOLATOR WILL NOT POWER UP

If you apply power to the Thermolator and the control panel does not light, you have a problem with the main power circuit or the unit's microprocessor board.



**WARNING: Electrical Shock Hazard**  
Disconnect and lockout the main power supply before proceeding.

Symptom	Possible cause	Solution
Applying power does not turn on the Thermolator or light the control panel.	Is power reaching the Thermolator?	<ul style="list-style-type: none"> <li><input type="checkbox"/> Verify that the main power supply and any customer-installed electrical disconnect or emergency stop devices are in the ON position.</li> <li><input type="checkbox"/> Verify correct electrical connections between the unit and the control, and between the unit and the power supply. Replace any damaged wires or cables.</li> </ul>
	Has the unit blown a fuse?	Check Fuse 1 on the motherboard and any fuses or breakers associated with customer-installed disconnect devices. Replace or reset as required. Identify the cause of the ground fault and correct it. <a href="#">See Checking and Replacing Fuses.</a>
	Is the correct voltage reaching the Thermolator?	Check the electrical requirements on the unit nameplate. Verify correct main supply voltage to the unit and the secondary voltage supply from the transformer to unit components. Replace the transformer, if necessary.
The control panel is lit, but the Thermolator will not operate when RUN is pressed.	Is the unit in Test Mode?	If the Test Mode LED is lit, you must disable Test Mode on the motherboard before resuming operation. <a href="#">See Performing System Tests</a> in the <i>MAINTENANCE</i> section.

This procedure covers the factory-installed fuses on the unit's motherboard. If you have installed an electrical disconnect or emergency stop switch, additional fuses and/or breakers may have been used elsewhere in the in the main power circuit.

**To replace a blown fuse:**

- 1** **Disconnect and lockout the main power.**
- 2** **Open the electrical enclosure door.** Turn the screw on the front panel counterclockwise to open.
- 3** **Replace the fuse.** The fuses are located on the motherboard and are labeled and identified on the orange shield.
- 4** **Close the electrical enclosure and restart the unit.**

**If fuses continue to fail:**

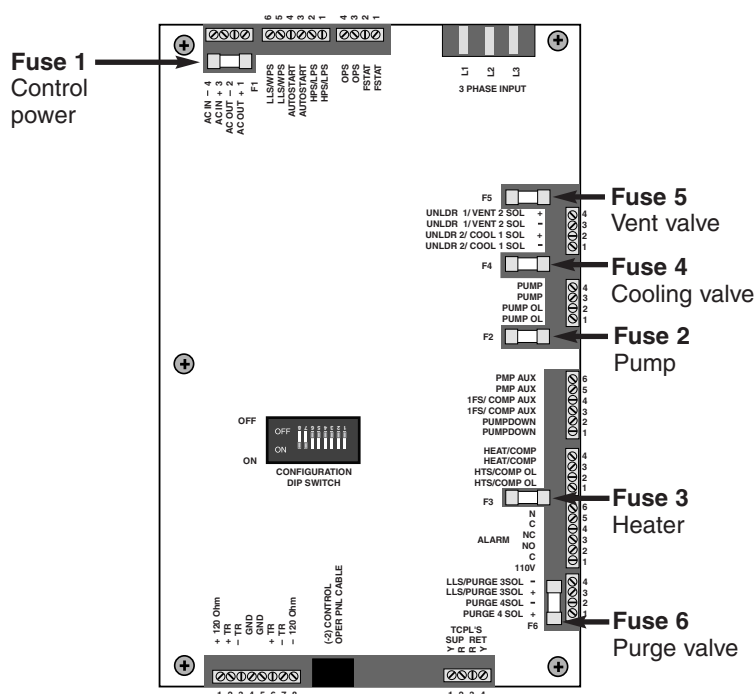
- ☐ Verify that the unit is receiving the correct voltage. Check the voltage, phasing and amperage ratings on the unit's nameplate.
- ☐ Verify that the unit's transformer is operating correctly. Check for proper voltage (120V 10%) to the voltage sensing device for the fuse location.
- ☐ Check all wiring referencing the fusing location for loose connections, damage or improper grounding. Verify that the correct device is being used for this fuse location. **See [Disabling or Enabling Output Monitors](#)** in the *MAINTENANCE* section.

## CHECKING AND REPLACING FUSES



### **WARNING:** Shock Hazard

Only qualified service personnel familiar with electrical testing and industrial equipment should examine and correct problems that require opening the unit with power on to diagnose the cause of a problem.



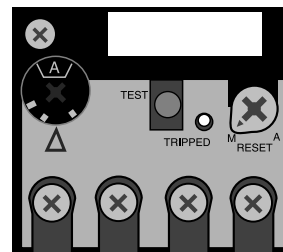
**IMPORTANT:** Always refer to the wiring diagrams that came with your Thermolator to locate specific electrical components. Illustrations in the User Guide are intended to be representative only.

## RESETTING OVERLOADS

The pump motor overload is located inside the unit's electrical enclosure.

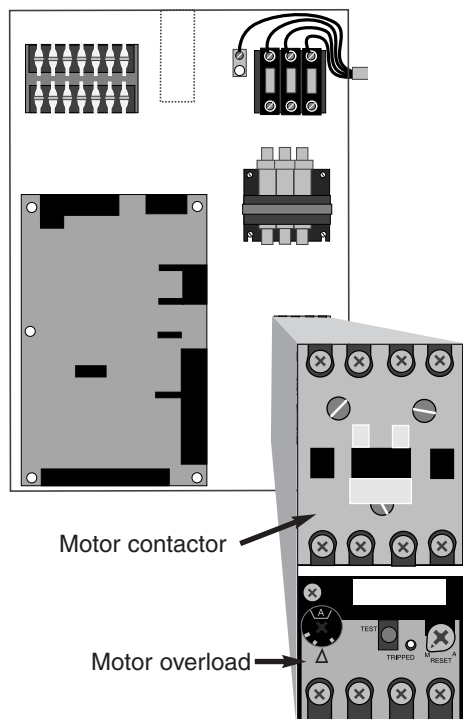
- 1 Disconnect and lockout the main power.**
- 2 Open the electrical enclosure door.** Turn the screw on the front panel counterclockwise to open.
- 3 Check the overload.**

If the yellow button is out, the overload has tripped. Press the blue button to reset the overload. Verify that the overload trip point does not exceed the FLA for the pump.



## REPLACING THE PUMP OVERLOAD

- 1 Disconnect and lockout the main power.**
- 2 Open the electrical enclosure door.** Turn the screw on the front panel counterclockwise to open.
- 3 Locate the pump overload module** attached to the pump motor starter.
- 4 Disconnect the three power leads** from the overload module to the pump motor. Note the placement of each lead and label as needed.



- 5 Disconnect auxiliary wiring on the overload module.**
- 6 Remove the overload module.** Loosen the three screws that connect the overload module to the motor contactor. Pull the overload module down to release it from the starter.
- 7 Reverse these steps to install the new overload module.**
- 8 Set the module reset mode to M for manual.**
- 9 Set the proper FLA trip point.** Do not exceed the FLA for the pump motor.



# REPLACING THE MOTHERBOARD

- 1** Disconnect and lockout the main power supply.
- 2** Open the electrical enclosure door. Turn the screw on the front panel counterclockwise to open.

- 3** Mark or label each wire connected to the motherboard. The orange shield is labeled with the connection information. You must label the wires to ensure they are connected to the correct terminals on the new motherboard.

- 4** Disconnect the wires from the motherboard by pulling the terminal blocks up.

- 5** Loosen the screws holding the orange shield.

- 6** Remove the motherboard and shield from the electrical enclosure as a unit.

- 7** Remove the motherboard from the shield and replace with the new motherboard.

- 8** Reattach the shield and new motherboard in the electrical enclosure. Tighten the screws.

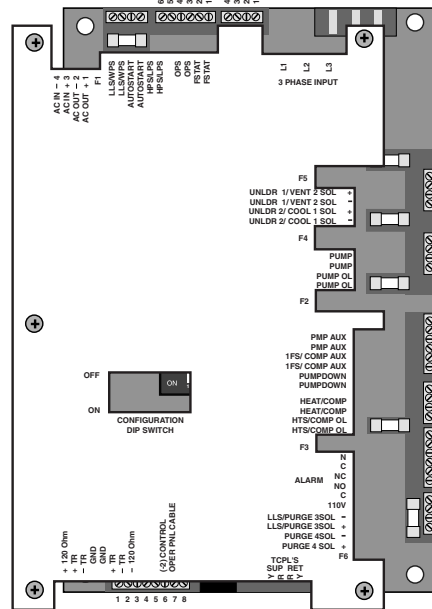
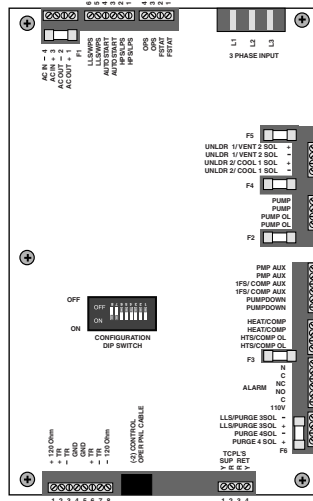
- 9** Reconnect the terminal blocks and wires to the new board.

Make sure you align the terminal blocks with the correct pins on the board. Push the terminal blocks onto the pins, taking care not to bend any pins.

- 10** Set dip switches 7 and 8 to the correct unit type. Set ON for DI and CC models; set off for IC models.

- 11** Program output monitors on the new board. See [Disabling or Enabling Output Monitors](#) in the *MAINTENANCE* section.

**IMPORTANT:** Always refer to the wiring diagrams that came with your Thermolator to locate specific electrical components. Illustrations in the User Guide are intended to be representative only.





# REPLACING THE HEATER CONTACTOR

**IMPORTANT:** Always refer to the wiring diagrams that came with your Thermolator to locate specific electrical components. Illustrations in the User Guide are intended to be representative only.



## WARNING: Electrical Shock Hazard

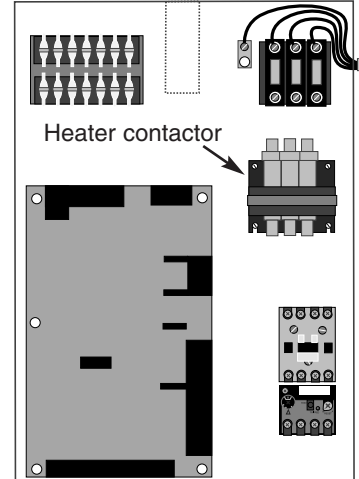
Only qualified service personnel who have been trained on electrical testing and the procedures for avoiding the hazards should diagnose or correct problems that require opening the unit with power on.

Thermolators use mercury displacement heater contactors. The heater contactors should be replaced if:

- You have checked the amp draw on each of the three-phase legs and discovered a voltage imbalance greater than 10%.
- You have checked the continuity and found that ohms at the coil equal zero.

### To replace the heater contactor:

- 1 Disconnect and lockout the main power.**
- 2 Open the electrical enclosure door.** Turn the screw on the front panel counterclockwise to open.
- 3 Disconnect the wires from the heater contactor contactor.** Make sure you label the wires to ensure you can connect them correctly to the new contactor.
- 4 Remove the contactor** by removing the screws that hold it in place.
- 5 Discard the old contactor using the proper disposal procedure.** See [Material Safety Data Sheet #7439-97](#) in the *APPENDIX*.
- 6 Reverse this procedure to install the new contactor.** Make sure the wires are connected correctly.



## WARNING: Hazardous Substance

Thermolators use mercury displacement contactors. Mercury is considered a hazardous substance and must be dealt with accordingly. See [Material Safety Data Sheet #7439-97-6](#) for information on the how to avoid the potential hazards and how to clean up and dispose of mercury if it spills.

The Thermolator uses two type ‘K’ thermocouples to monitor supply and return process temperatures. One thermocouple is installed in the wall of the heater tank at the “to process” outlet. The other thermocouple is installed in the wall of the cooling tank at the “from process” inlet.

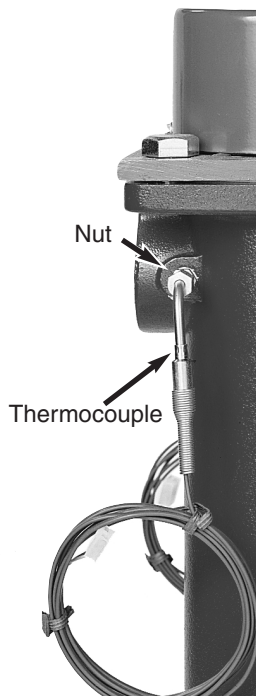
## CHECKING THERMOCOUPLES

**To check a thermocouple after a probe error:**

- 1 Disconnect and lockout the main power.**
- 2 Open the electrical enclosure door.** Turn the screw on the front panel counterclockwise to open.
- 3 Unplug the appropriate thermocouple from the motherboard and install a jumper on the leads.** Refer to the wiring diagrams that came with your unit.
- 4 Restart the Thermolator.**
  - ◆ If error message disappears, replace the thermocouple.
  - ◆ If error message does not disappear, replace the motherboard. See **Replacing the Motherboard**.

**To replace a thermocouple:**

- 1 Disconnect and lockout the main power.**
- 2 Shut off the cooling water infeed and drain the unit.** Drain all water using the drain plugs located the bottom of the unit.
- 3 Remove the unit’s top panel and open the electrical enclosure**
- 4 Remove the thermocouple.** Loosen the compression nut to slide the thermocouple out of the casing. Disconnect the thermocouple wires at the motherboard.
- 5 Install the new thermocouple.** Insert the tip of the new thermocouple at least 1 inch into the tank. Tighten the compression nut. Thread the leads through the raceway leading to the electrical enclosure. Attach the thermocouple leads to the motherboard.



## REPLACING THERMOCOUPLES



### **WARNING:** **Hot surfaces**

Allow the Thermolator to cool to below 100° F (38° C) before servicing the unit.

# REPAIRING SOLENOID VALVES

Every Thermolator has a solenoid valve assembly that controls the cooling water out flow. Closed circuit (CC) and Isolated Circuit (IC or TCC) units also have a vent valve assembly. Solenoid valves also are found on the optional purge valve.



## **WARNING: Electrical shock and hot surface hazards**



Before attempting maintenance of any kind on the Thermolator, you must stop the unit; disconnect and lockout the main power supply; and allow the unit to cool to 100° F (38° C)

- 1 Shut off the cooling water infeed.**

- 2 Drain the unit of all water** through the draining plugs in the rear of the unit.

- 3 Remove the cooling water out feed.** For closed and isolated circuit models, also remove the cooling water in feed.

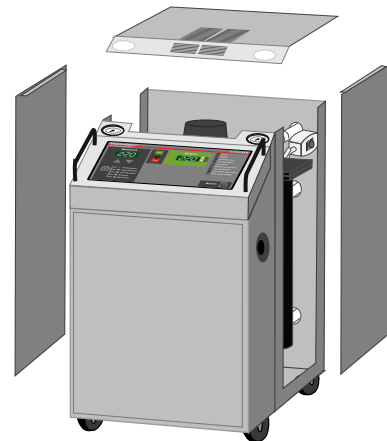
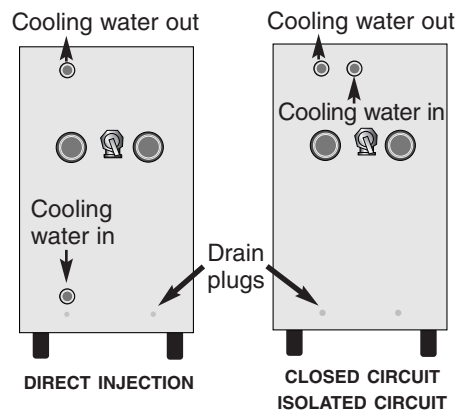
- 4 Disconnect and lock-out main power.**

- 5 Remove the top and side panels of the Thermolator.** Lift the top panel straight up, then lift the side panels up.

- 6 Remove the solenoid valve from the cooling water out line.**

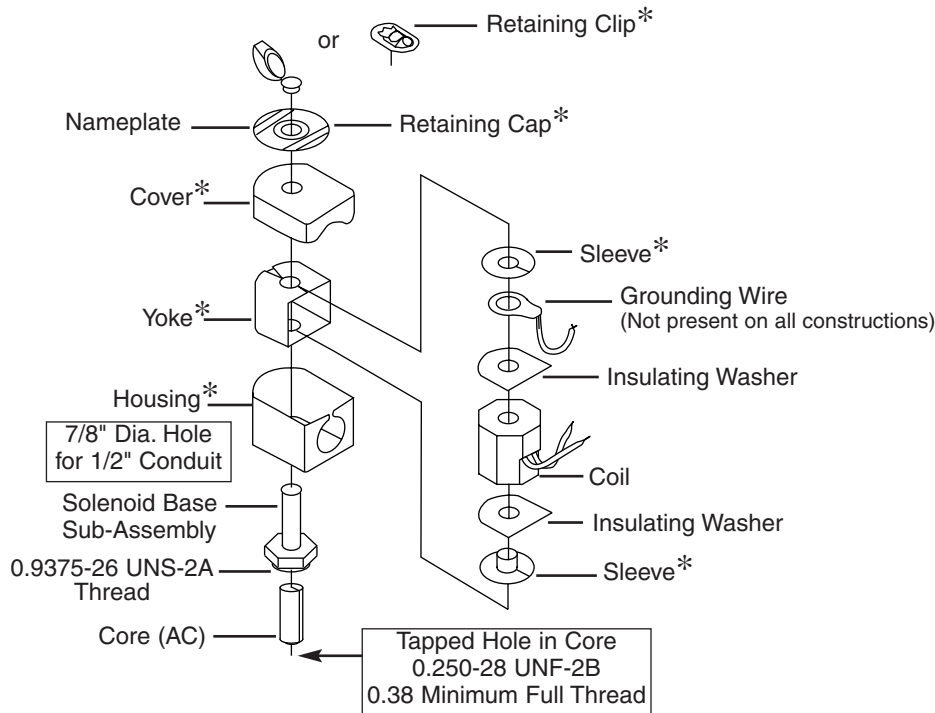
- 7 Disassemble the solenoid valve.**  
(See exploded views on next page.)

- 8 Inspect and clean or repair the valve body assembly.** Remove foreign particles and replace damaged parts as necessary.



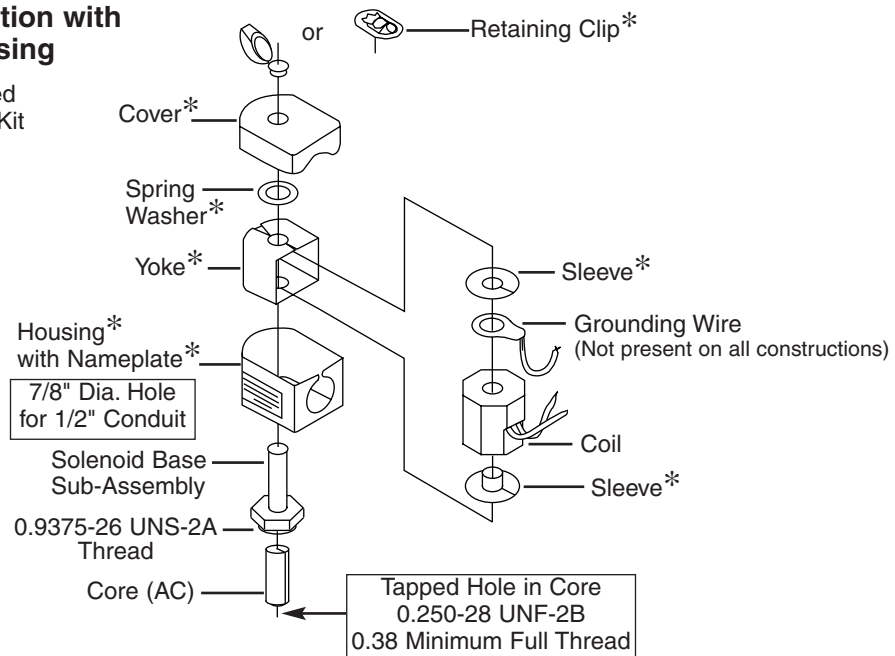
\*Indicates Parts Supplied  
in Solenoid Enclosure Kit

# REPAIRING SOLENOID VALVES



## Alternate Construction with Nameplate on Housing

\*Indicates Parts Supplied  
in Solenoid Enclosure Kit



## 9 Reassemble the valve and other components.

Reassemble in reverse order. Seal all pipe fittings with pipe sealant. Check that all flows are in the correct direction. Check for leaks before resuming operation.

# REPLACING HEATER ELEMENTS



## **WARNING: Electrical shock and hot surface hazards**

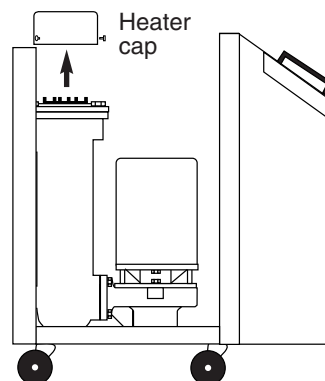
Before attempting maintenance of any kind on the Thermolator, you must stop the unit; disconnect and lockout the main power supply; and allow the unit to cool to less than 100° F (38° C)

**1** Disconnect and lockout the main power.

**2** Remove the top panel of the Thermolator.

**3** Remove the heater cap.

Use a 1/4-inch open-end wrench to remove the three bolts that hold the cap to the heater tank.

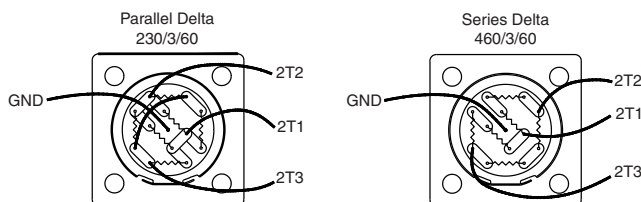


**4** Remove the heater wiring harness.

Label the wiring layout of the heater terminals; wires are labeled 2T1, 2T2, 2T3 and GND.

The wiring layout will be one of the following:

### HEATER TERMINAL CONNECTIONS



Then unscrew the locking screws on the wiring harness and remove the wires.

**5** Shut off the cooling water infeed.

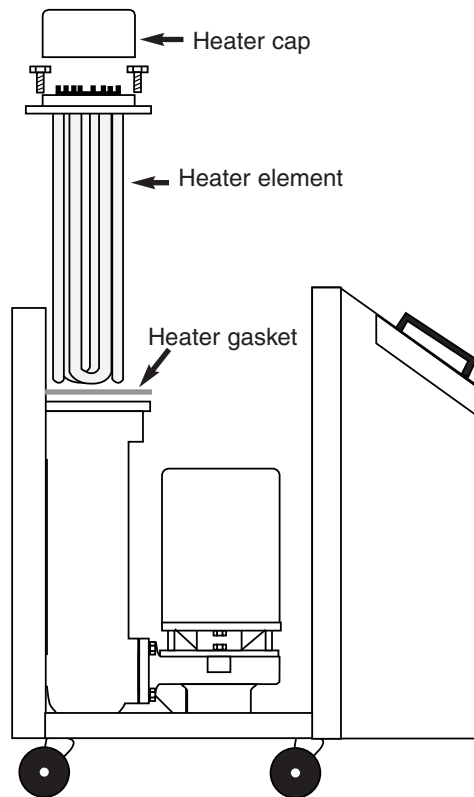
**6** Drain the Thermolator using the drain plugs located at the rear of the unit.

**7** Remove the four bolts that hold the heater element in place. Use a 15/16-inch socket with 1/2-inch drive.

**IMPORTANT:** Always refer to the wiring diagrams that came with your Thermolator to locate specific electrical components. Illustrations in the User Guide are intended to be representative only.

## REPLACING HEATER ELEMENTS

- 8** Lift the heating element out of the heater tube.  
Lift the element straight up.



- 9** Replace the heater gasket if it is worn or cracked.  
Use a high temperature Teflon paste to ensure a good seal.
- 10** Reverse these steps to install the new heater element and reassemble the unit.

# REMOVING THE PUMP



## **WARNING: Electrical shock and hot surface hazards**

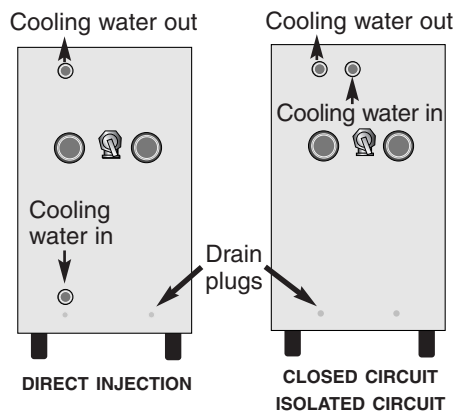
Before attempting maintenance of any kind on the Thermolator, you must stop the unit; disconnect and lockout the main power supply; and allow the unit to cool to less than 100° F (38° C)

**1 Disconnect and lockout the main power.**

**2 Shut off the cooling water in feed.**

**3 Drain the unit of all fluid.** Remove the drain plugs at the rear of the unit.

**4 Remove the top and side panels of the Thermolator.**

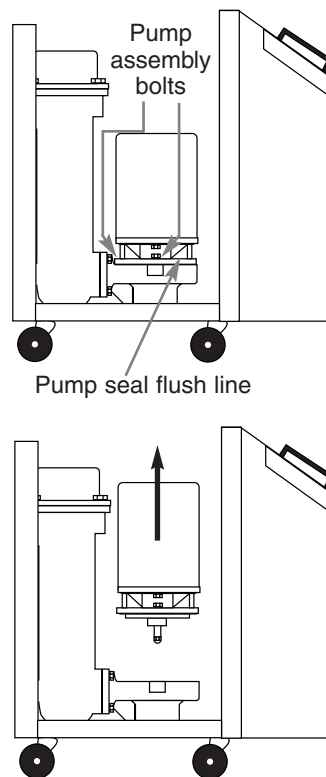


**5 Remove the seal flush line.** Use a 1/2-inch open-end wrench to remove the vent line from the connection on the pump adapter.

**6 Remove the pump assembly bolts.** Use a 9/16-inch open-end box wrench to remove the bolts holding the pump to the volute case. The bolt in the rear will require a 9/16-inch crows foot wrench.

**7 Lift the pump assembly straight up to remove.** The pump can now be replaced or disassembled for repair.

**8 Reverse the steps to reassemble the unit.**

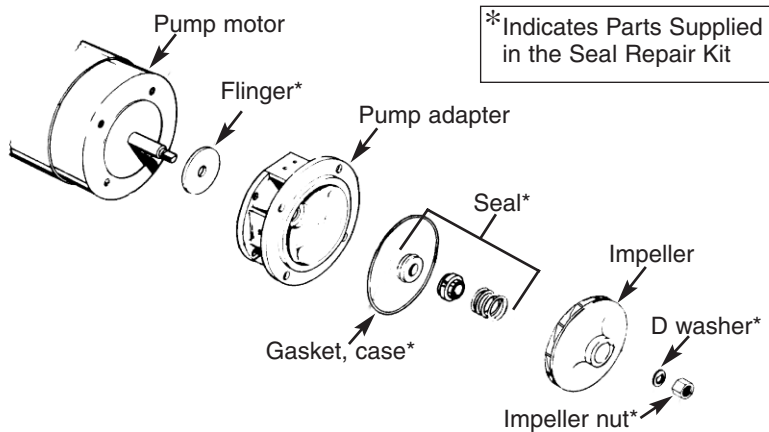


**NOTE:** Before restarting, close all drain openings using sealant on the threads and reprime the pump. Do not start until the pump is completely filled with water.

## DISASSEMBLING AND ASSEMBLING 3/4 - 2 HP PUMPS

To replace a failed seal, you must disassemble the pump.

- 1 Remove the impeller nut.** Insert a screwdriver in one of the impeller waterway passages and back off the impeller nut.
- 2 Remove the impeller.** Insert a screwdriver in the slot of the motor shaft. Unscrew the impeller while holding the shaft against the rotation.
- 3 Remove the seal, gasket case, adapter and flinger.** See the exploded view for detail.



- 4 Clean the gasket and flange faces, seal seat cavity and shaft.** The shaft shoulder that fits against the impeller must be clean.
- 5 Replace the flinger.** Lubricate the seal seat cavity of the adapter and the flinger with soapy water solution before pressing the flinger squarely into the cavity. Do not chip or scratch the lapped seat face.
- 6 Remount the adapter to the motor.** Make sure the motor shaft does not dislocate or chip the seat of the seal.
- 7 Replace the remaining seal components.** Apply a soapy water solution to the motor shaft and the rubber bellows of the rotating seal. Be sure the rotating seal face stays in the holding collar during installation. Do not chip or scratch the lapped seat faces.
- 8 Reassemble the remaining components,** holding the shaft against rotation as previously described. Remove any burrs caused by the screwdriver on the impeller.
- 9 Reattach the pump to the volute case.** Make sure you replace any damaged gasket or O-ring between the pump assembly and volute case. Check for free rotation after assembly is completed.

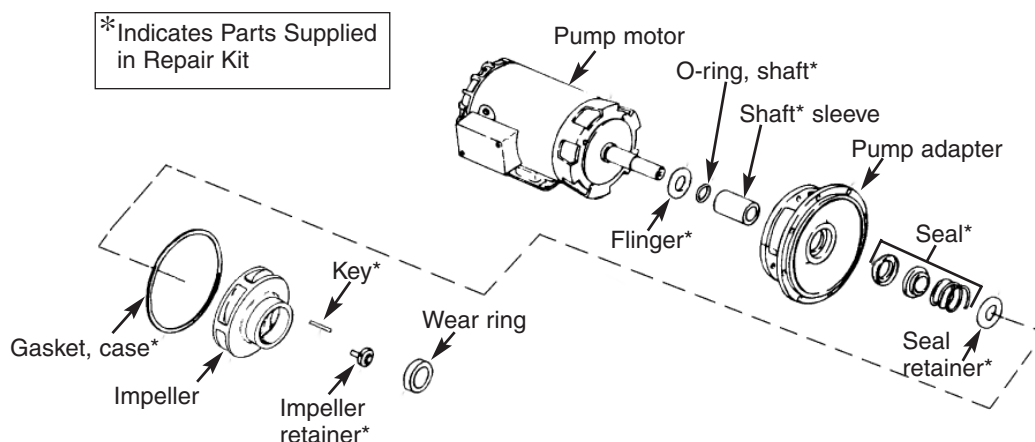
**NOTE:** Before restarting, close all drain openings using sealant on the threads and refill the unit with fluid. Do not start the pump when the unit is dry.



# DISASSEMBLING AND ASSEMBLING 3 - 7.5 HP PUMPS

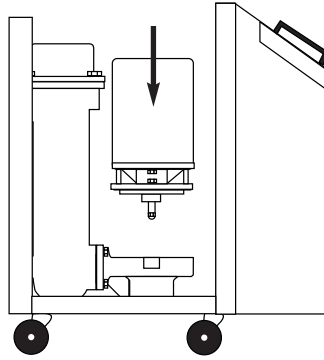
To replace a failed seal, you must disassemble the pump.

- 1 Remove the impeller retaining assembly.** Insert a screwdriver in one of the impeller waterway passages to hold the impeller steady while removing the retainer.
- 2 Remove the impeller.** Be careful not to lose the key, spring and seal retainer. If the impeller is difficult to remove, you may need to use a bearing puller.
- 3 Remove the seal, adapter, shaft and flinger.** See the exploded view for detail.



- 4 Clean the gasket and flange faces, seal seat cavity, shaft sleeve and motor shaft.** Replace the shaft sleeve if it is damaged or worn.
- 5 Replace the flinger.** Lubricate the seal seat cavity of the adapter and the flinger with soapy water solution before pressing the flinger squarely into the cavity. Do not chip or scratch the lapped seat face.
- 6 Remount the adapter to the motor.** Make sure the motor shaft does not dislocate or chip the seat of the seal.
- 7 Replace the remaining seal components.** Apply a soapy water solution to the motor shaft and the rubber bellows of the rotating seal. Slide the rotating member of the seal over the shaft sleeve. Replace the seal spring and seal retainer, making sure the rotating seal face stays in the holding collar during installation. Do not chip or scratch the lapped seat faces.
- 8 Place the key in the key seat and slide the impeller on the shaft.** Replace the impeller retaining nut. Remove any burrs caused by the screwdriver on the impeller.

- 
- 9** **Reattach the pump to the volute case.** Make sure you replace any damaged gasket or O-ring between the pump assembly and volute case. Check for free rotation after assembly is completed.



## DISASSEMBLING AND ASSEMBLING 3 - 7.5 HP PUMPS

**NOTE:** Before restarting, close all drain openings using sealant on the threads and and refill the unit with fluid. Do not start the the pump when the unit is dry.



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Conair has made the largest investment in customer support in the plastics industry. Our service experts are available to help with any problem you might have installing and operating your equipment. Your Conair sales representative also can help analyze the nature of your problem, assuring that it did not result from misapplication or improper use.

## WE'RE HERE TO HELP

To contact Customer Service personnel, call:



## HOW TO CONTACT CUSTOMER SERVICE

From outside the United States, call: 814-437-6861

You can commission Conair service personnel to provide on-site service by contacting the Customer Service Department. Standard rates include an on-site hourly rate, with a one-day minimum plus expenses.

### If you do have a problem, please complete the following checklist before calling Conair:

- ☐ Make sure you have all model, serial and parts list numbers for your particular equipment. Service personnel will need this information to assist you.
- ☐ Make sure power is supplied to the equipment.
- ☐ Make sure that all connectors and wires within and between control systems and related components have been installed correctly.
- ☐ Check the troubleshooting guide of this manual for a solution.
- ☐ Thoroughly examine the instruction manual(s) for associated equipment, especially controls. Each manual may have its own troubleshooting guide to help you.
- ☐ Check that the equipment has been operated as described in this manual.
- ☐ Check accompanying schematic drawings for information on special considerations.

## BEFORE YOU CALL ...

*Additional manuals and prints for your Conair equipment may be ordered through the Customer Service or Parts Departments for a nominal fee.*

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## EQUIPMENT GUARANTEE

Conair guarantees the machinery and equipment on this order, for a period as defined in the quotation from date of shipment, against defects in material and workmanship under the normal use and service for which it was recommended (except for parts that are typically replaced after normal usage, such as filters, liner plates, etc.). Conair's guarantee is limited to replacing, at our option, the part or parts determined by us to be defective after examination. The customer assumes the cost of transportation of the part or parts to and from the factory.

## PERFORMANCE WARRANTY

Conair warrants that this equipment will perform at or above the ratings stated in specific quotations covering the equipment or as detailed in engineering specifications, provided the equipment is applied, installed, operated and maintained in the recommended manner as outlined in our quotation or specifications.

Should performance not meet warranted levels, Conair at its discretion will exercise one of the following options:

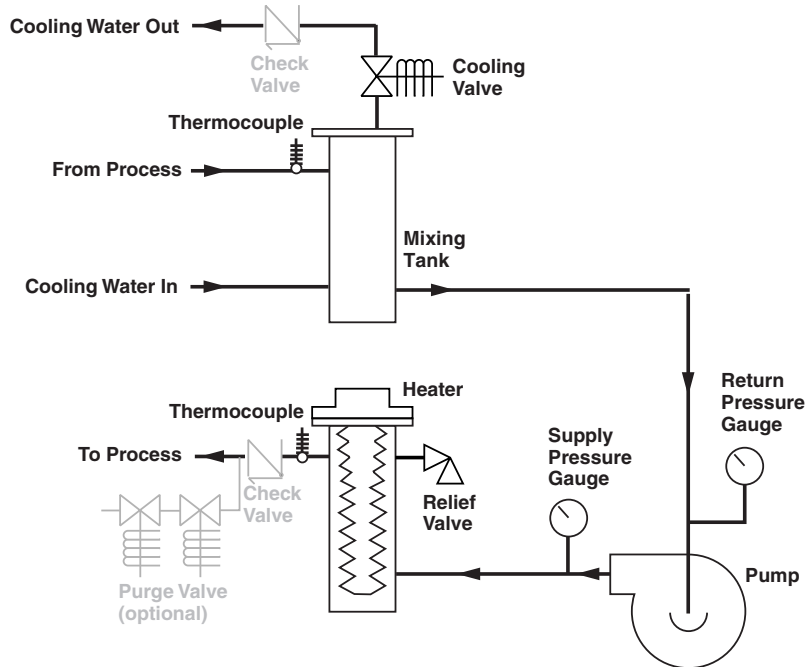
- Inspect the equipment and perform alterations or adjustments to satisfy performance claims. (Charges for such inspections and corrections will be waived unless failure to meet warranty is due to misapplication, improper installation, poor maintenance practices or improper operation.)
- Replace the original equipment with other Conair equipment that will meet original performance claims at no extra cost to the customer.
- Refund the invoiced cost to the customer. Credit is subject to prior notice by the customer at which time a Return Goods Authorization Number (RGA) will be issued by Conair's Service Department. Returned equipment must be well crated and in proper operating condition, including all parts. Returns must be prepaid.

Purchaser must notify Conair in writing of any claim and provide a customer receipt and other evidence that a claim is being made.

## WARRANTY LIMITATIONS

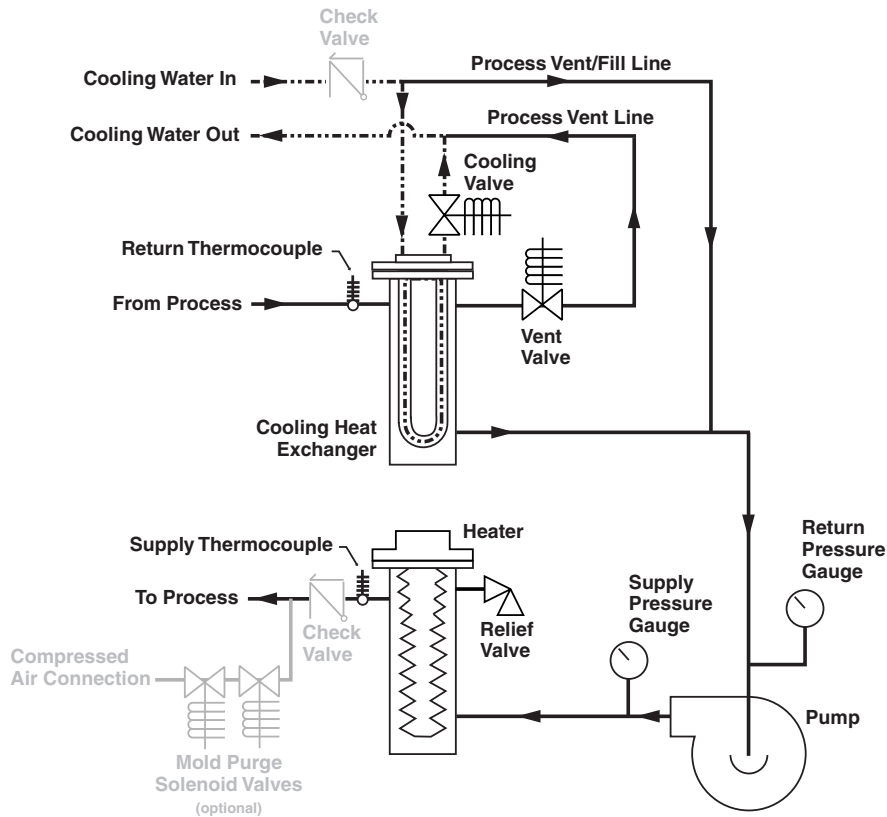
**Except for the Equipment Guarantee and Performance Warranty stated above, Conair disclaims all other warranties with respect to the equipment, express or implied, arising by operation of law, course of dealing, usage of trade or otherwise, including but not limited to the implied warranties of merchantability and fitness for a particular purpose.**

# PLUMBING DIAGRAMS



## Direct Injection

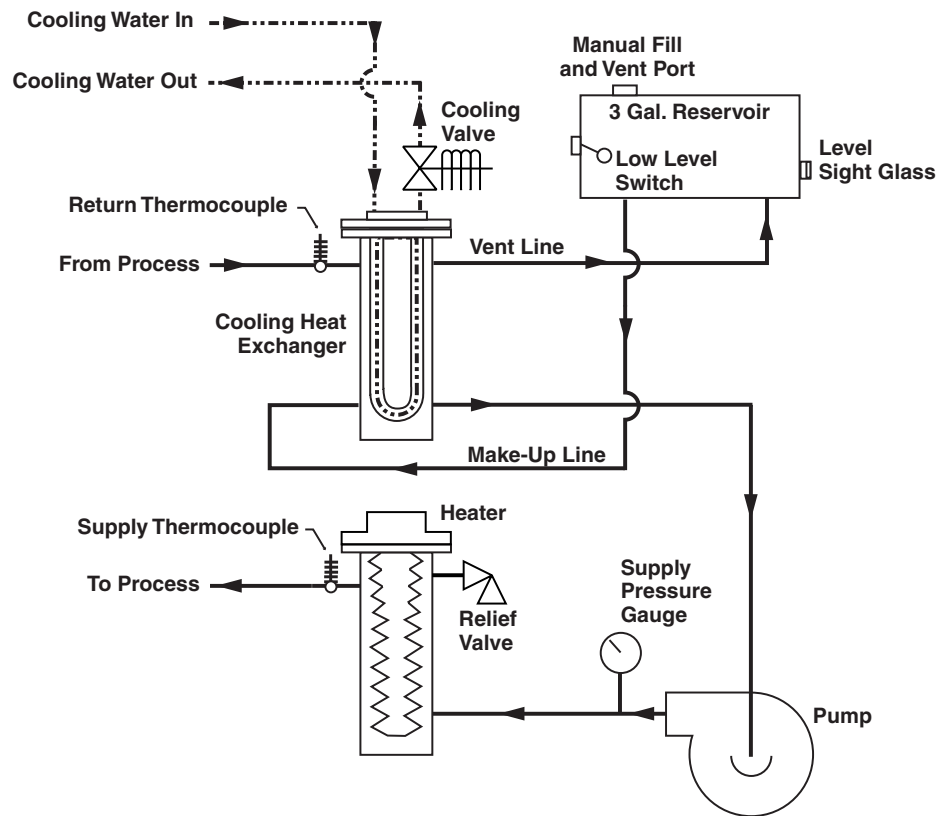
Check valves included only with optional mold purge.



## Closed Circuit

Check valves included only with optional mold purge.

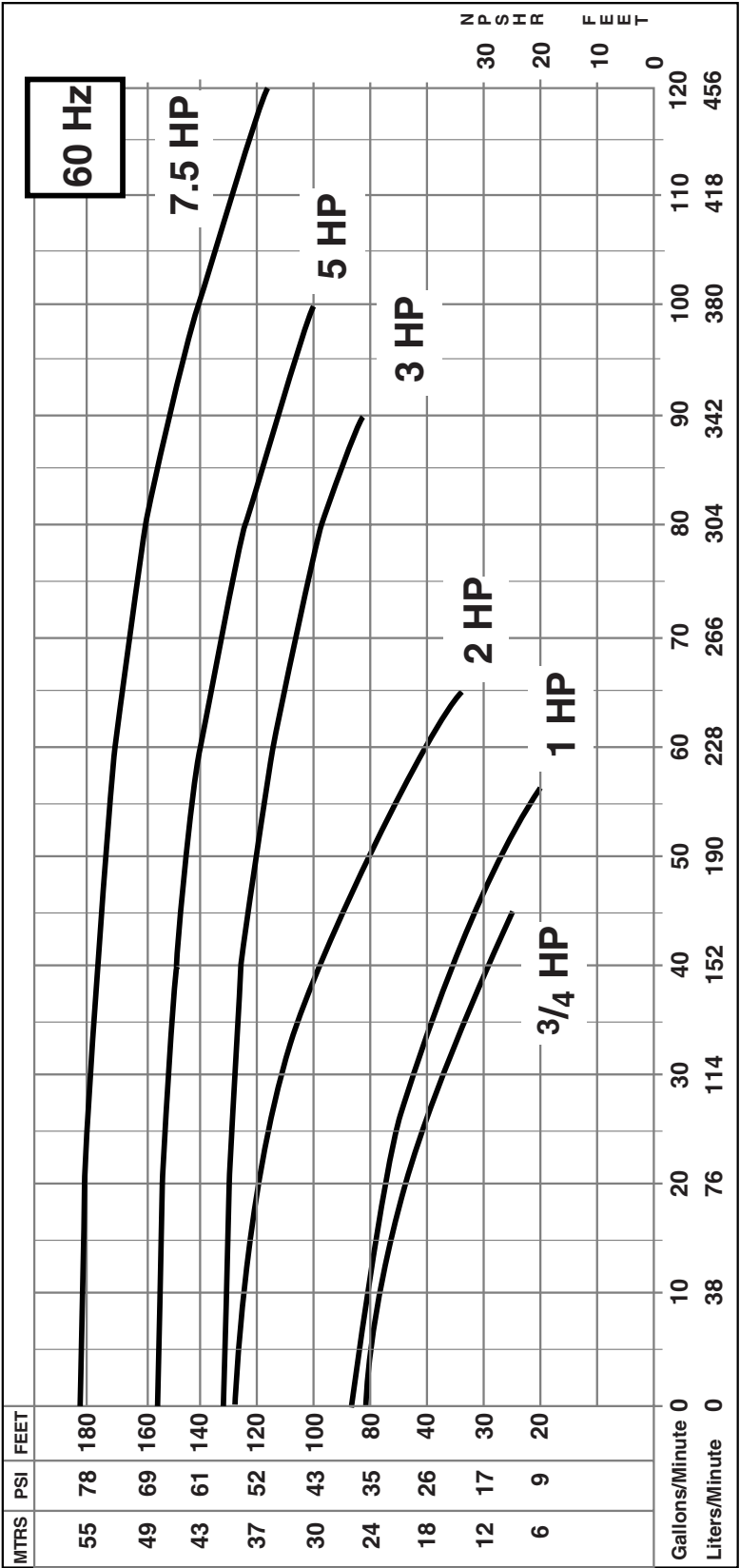
# PLUMBING DIAGRAMS



## Isolated Circuit

NOTE: There is a 180° F operating temperature limit on isolated circuit units.

# PUMP CURVES







The SPI commands supported by Conair Thermolator® mold temperature controllers are listed in the following tables.

The standard required commands and three optional commands are listed in the SPI Command Pairs table, along with the Select and Poll command pairs in hexadecimal format. Select commands set or change Thermolator functions. Poll commands retrieve information from the Thermolator.

# SPI COMMANDS SUPPORTED BY THE CONAIR THERMOLATOR®

<b>SPI Command Pairs</b>		
<b>Mold temperature controllers</b>		<b>Device ID: hex 20</b>
<b>Commands</b>	<b>Select</b>	<b>Poll</b>
<b>Echo</b> - Select stores 4 bytes of information at the Thermolator; Poll retrieves it.	0x20 0x21	0x20 0x20
<b>Setpoint Process Temperature</b> - Sets and retrieves the process temperature setpoint.	0x20 0x31	0x20 0x30
<b>Alarm, High Temperature Deviation*</b> - Sets the alarm band temperature; retrieves setpoint + alarm band value.	0x20 0x33	0x20 0x32
<b>Alarm, Low Temperature Deviation*</b> - Sets the alarm band temperature; retrieves setpoint + alarm band value.	0x20 0x35	0x20 0x34
<b>Mode, Machine</b> - Start/stops the Thermolator; acknowledges alarms; retrieves run status	0x20 0x49	0x20 0x48
<b>Version</b> - Retrieves 4 bytes of SPI version information.		0x20 0x22
<b>Process Status</b> - Retrieves run status and alarm conditions.		0x20 0x40
<b>Status, Machine 1</b> - Retrieves run status and alarm conditions.		0x20 0x42
<b>Status, Machine 2</b> - Retrieves run status and alarm conditions.		0x20 0x44
<b>Temperature, from Process</b> - Retrieves the actual temperature of fluid returning to the Thermolator.		0x20 0x72
<b>* NOTE: Both High and Low Temperature Deviation commands set the same variable. Use only one of these commands to avoid problems.</b>		

See the tables on the following pages for the SPI status words and BIT positions for Process Status, Machine 1 Status and Machine 2 status.

For more information on the SPI protocol, you can obtain the SPI Communication Protocol Manual by contacting:

The Society of the Plastics Industry, Inc.  
1801 K Street, NW  
Suite 600K  
Washington DC 20006  
(202) 974-5200 Fax: (202) 296-7005  
[www.plasticsindustry.org](http://www.plasticsindustry.org)

# SPI STATUS WORDS

Status, Process																
Poll: 0x20 0x40																
SPI STATUS WORD	Open	Open	Reserved	Reserved	Reserved	Reserved	Alarm, Low flow	Reserved	Alarm, Low pressure condition	Alarm, High pressure condition	Alarm, Low temperature deviation	Alarm, High temperature deviation	Alarm, Machine	Alarm, Process	Alarm, System	Processing
Word BIT position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
EEprom error														SET	SET	*
A/D converter error														SET	SET	*
CJC Error														SET	SET	*
RAM hardware														SET	SET	*
ROM checksum														SET	SET	*
Probe Failure													SET		SET	*
E/M Hi temp safety																*
Prog. Hi temp safety																*
Output monitor failure													SET		SET	*
Low water pressure									SET				SET		SET	*
High deviation alarm												SET		SET	SET	*
Low deviation alarm											SET			SET	SET	*
Prog. Lo temp safety																*
Pump overload													SET		SET	*
Low water level													SET		SET	*
Test Mode																*
Phase error																*

**NOTES:**

- \* The SPI I/O list defines the Processing bit as being cleared if the unit is not processing; otherwise it is SET.

**Elsewhere on the chart:**

- If a bit is not shown to be SET, it is cleared.
- The System Alarm bit is SET if an alarm is present. It is the logical OR of Process alarm and Machine alarm.
- Processing, System Alarm, Process Alarm and Machine Alarm bits are repeated for Process Status, Machine 1 Status and Machine 2 Status.

# SPI STATUS WORDS

## Status, Machine 1

Poll: 0x20 0x42

SPI STATUS WORD	Open	Alarm, Phase	Alarm, Low current	Alarm, High current	Alarm, Low volts	Alarm, High volts	Reserved	Reserved	Alarm, Low pressure safety limit	Alarm, High pressure safety limit	Alarm, Low temperature safety limit	Alarm, High temperature safety limit	Alarm, Machine	Alarm, Process	Alarm, System	Processing
Word BIT position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
EEPROM error														SET	SET	*
A/D converter error														SET	SET	*
CJC Error														SET	SET	*
RAM hardware														SET	SET	*
ROM checksum														SET	SET	*
Probe Failure																*
E/M Hi temp safety												SET	SET		SET	*
Prog. Hi temp safety												SET		SET	SET	*
Output monitor failure													SET		SET	*
Low water pressure									SET				SET		SET	*
High deviation alarm																*
Low deviation alarm																*
Prog. Lo temp safety											SET			SET	SET	*
Pump overload													SET		SET	*
Low water flow													SET		SET	*
Low water level													SET		SET	*
Test Mode																*
Phase error		SET											SET		SET	*

### NOTES:

\* The SPI I/O list defines the Processing bit as being cleared if the unit is not processing; otherwise it is SET.

#### Elsewhere on the chart:

- If a bit is not shown to be SET, it is cleared.
- The System Alarm bit is SET if an alarm is present. It is the logical OR of Process alarm and Machine alarm.
- Processing, System Alarm, Process Alarm and Machine Alarm bits are repeated for Process Status, Machine 1 Status and Machine 2 Status.

# SPI STATUS WORDS

## Status, Machine 2

Poll: 0x20 0x44

SPI STATUS WORD	Open	Open	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Fault, CAL	Fault, Sensor	Alarm, Machine	Alarm, Process	Alarm, System	Processing
Word BIT position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
EEProm error														SET	SET	*	
A/D converter error														SET	SET	*	
CJC Error														SET	SET	*	
RAM hardware														SET	SET	*	
ROM checksum														SET	SET	*	
Probe Failure												SET		SET	SET	*	
E/M Hi temp safety																	*
Prog. Hi temp safety																	*
Output monitor failure													SET		SET	*	
Low water pressure																	*
High deviation alarm																	*
Low deviation alarm																	*
Prog. Lo temp safety																	*
Pump overload													SET		SET	*	
Low water level													SET		SET	*	
Test Mode																	*
Phase error																	*

### NOTES:

\* The SPI I/O list defines the Processing bit as being cleared if the unit is not processing; otherwise it is SET.

#### Elsewhere on the chart:

- If a bit is not shown to be SET, it is cleared.
- The System Alarm bit is SET if an alarm is present. It is the logical OR of Process alarm and Machine alarm.
- Processing, System Alarm, Process Alarm and Machine Alarm bits are repeated for Process Status, Machine 1 Status and Machine 2 Status.

# Material Safety Data Sheet

An explanation of the terms used in this document may be found in OSHA 29 CFR 1910.1200, which is available from OSHA regional or area offices.

## MSDS: 7439-97-6 MERCURY

1. Chemical Identification		
<b>Substance:</b> Mercury	<b>CAS-Number:</b> 7439-97-6	
<b>Chemical name:</b> Mercury	<b>Synonyms:</b> Quicksilver; Liquid silver	
<b>Formula:</b> HG	<b>Molecular weight:</b> 200.59	
<b>Trade name:</b> Not applicable	<b>Chemical family:</b> Metal	
<b>Supplier of MSDS information:</b> The Conair Group Inc. One Conair Drive Pittsburgh, PA 15202 412-312-6000		<b>Emergency contact:</b> For CHEMTREC assistance call 800-424-9300 (in the U.S.) 703-527-3887 (international)
2. Composition and Exposure Limits		
Material	Weight (%)	Exposure Limits
Mercury	100	0.05 mg/m <sup>3</sup> Threshold Limit Value(skin)/TWA
		0.1 mg/m <sup>3</sup> Permissible Exposure Limit (PEL)
3. Hazards Identification		
<b>Hazard Ratings</b> (0 = no hazard; 4 = extreme hazard):		
Health	- 4 Extreme (Poison)	Carcinogenic: NTP – No
Flammability	- 0 None	IARC – No
Reactivity	- 1 Slight	Z List – No
Contact	- 3 Severe (Life)	OSHA Reg – No
<b>Personal Health Effects:</b>		
<b>WARNING</b> Mercury is a dangerous poison and an extreme contact hazard. Mercury may be absorbed by the skin or through the eyes. It may be fatal if swallowed or inhaled. It emits toxic vapors, especially when heated. Do not get mercury in your eyes, on your skin or on your clothing. Do not breathe mercury dust. Keep mercury in a tightly closed container. Use with adequate ventilation. Wash thoroughly after handling.		
<b>Effects of overexposure</b> Mercury causes skin, digestive tract and severe respiratory tract irritation. It may affect the central nervous system and cause severe eye irritation. Inhalation of vapors may cause coughing, chest pains, nausea and vomiting. Chronic effects of overexposure may include kidney and/or liver damage, and central nervous system depression. Chronic effects of mercury poisoning include a buildup of the metal in the brain, liver and kidneys. Symptoms include headache, tremors, loose teeth, loss of appetite, blisters on the skin and impaired memory. This substance has caused adverse reproductive and fetal effects in animals.		
<b>Target organs</b> Eyes, skin, respiratory system, central nervous system, kidneys and liver.		
<b>Routes of entry</b> Inhalation, absorption, eye contact, skin contact.		
4. Emergency and First Aid Measures		
<b>Call a physician immediately.</b>		
<b>If swallowed:</b>	Immediately induce vomiting, if person is conscious.	
<b>If inhaled:</b>	Immediately remove exposed person to fresh air. If the person is not breathing, give artificial respiration. If breathing is difficult, give oxygen.	
<b>In case of contact:</b>	Immediately flush eyes or skin with plenty of water for at least 15 minutes, while removing contaminated clothing and shoes. Wash clothing before using again.	

# MSDS:

## 7439-97-6

### MERCURY

5. Fire and Explosion Data	
<b>Fire and explosion hazards:</b>	Mercury presents a slight fire and explosion hazard when exposed to heat or flame. Mercury vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back.
<b>Firefighting media:</b>	Dry chemical, carbon dioxide, water spray or foam. For larger fires, use water spray, fog or alcohol foam. (1984 Emergency Response Guidebook, DOT P 5800.3).
<b>Firefighting procedures:</b>	Use agents suitable for type of fire. Use water in flooding amounts as a fog. Avoid breathing corrosive and poisonous vapors. Keep upwind. Move containers from the fire area if possible. Cool containers exposed to flames with water from side until well after fire is out. (1984 Emergency Response Guidebook, DOT P 5800.3).
6. Spill and Disposal Procedures	
<b>EPA Hazardous Waste Number:</b> U151 (Toxic Waste)	
<b>If spilled or discharged:</b>	Wear self-contained breathing apparatus and full protective clothing. Clean up the spill immediately. Collect and store using a suction pump with a capillary tube. Calcium polysulfide with excess sulfur should be sprinkled into cracks or inaccessible sites. Keep collected mercury in a tightly closed bottle for recovery or disposal.
<b>Disposal procedure:</b>	Dispose in accordance with all applicable federal, state, and local environmental regulations.
7. Storage and Handling Precautions	
Mercury should be stored in a secure poison area inside a tightly closed container.	
8. Exposure Control and Protective Equipment	
<b>Ventilation:</b>	Use general or local exhaust ventilation to meet TLV requirements.
<b>Respiratory protection:</b>	None required where appropriate ventilation conditions exist. If the TLV is exceeded, a self-breathing apparatus is advised.
<b>Eye/skin protection:</b>	Safety goggles and face shield, uniform, protective suit and rubber gloves are recommended.
9. Physical and Chemical Properties	
<b>Appearance and odor:</b> Silver-white, heavy, mobile liquid metal; odorless	
<b>Boiling point:</b> 675° F (357° C)	<b>Melting point:</b> -38° F (-39° C)
<b>Specific gravity:</b> 13.5	<b>Vapor pressure:</b> 0.002 mm HG
<b>Vapor density:</b> 1.01	<b>Solubility in H<sub>2</sub>O:</b> negligible, less than 0.1%
<b>Solubility in solvents:</b> Sulfuric acid, nitric acid, lipids	
10. Stability and Reactivity Data	
<b>Stability:</b> Stable	<b>Hazardous polymerization:</b> Will not occur
<b>Conditions to avoid:</b>	Heat
<b>Incompatibles:</b>	Strong acids

**IMPORTANT:** Users of this equipment should study this MSDS carefully to become aware of and understand the hazards associated with the product. If necessary or appropriate, the reader should consider consulting reference works or individuals who are experts in ventilation, toxicology and fire prevention to use and understand the data in this MSDS. To promote safe handling, the reader should furnish this information to anyone whom he or she knows or believes will use this equipment.

## PARTS/DIAGRAMS

- *Spare Parts Lists* . . . . .PD-1
- *TW-1 Wiring* . . . . .PD-5
- *TW-1 Circuit Board* . . . . .PD-6
- *TW-2 Wiring* . . . . .PD-7
- *TW-2 Circuit Board* . . . . .PD-8



# RECOMMENDED SPARE PARTS

## TW-1 and TW-2 Thermolators 208-230/460V 9kW & 12kW units ¾ HP through 7½ HP

<b>PUMP ASSEMBLIES</b> Nickle resistant seal, open drip proof type motor	
<b>Part No.</b>	<b>Description</b>
09000952	¾ HP pump model 11C (with cast iron impeller)
09000953	1 HP pump model 11C (with cast iron impeller)
09000954	2 HP pump model 12C (with brass impeller)
09000955	3 HP pump model 50C (with cast iron impeller)
09000956	5 HP pump model 50C (with cast iron impeller)
09000957	7½ HP pump model 50C (with cast iron impeller)
<b>PUMP ASSEMBLIES</b> Silicon carbide seal, open drip proof type motor	
<b>Part No.</b>	<b>Description</b>
09000958	¾ HP pump model 12CS (with stainless steel impeller)
09000959	1 HP pump model 12CS (with stainless steel impeller)
09000960	2 HP pump model 12CS (with brass impeller)
09000961	3 HP pump model 50CS (with bronze impeller)
09000962	5 HP pump model 50CS (with bronze impeller)
09000963	7½ HP pump model 50CS (with bronze impeller)
<b>PUMP SEAL OVERHAUL KITS</b>	
<b>Part No.</b>	<b>Description</b>
09000751	¾ HP through 2 HP nickle resistant seal - 11C, 12C
09000752	3 HP through 7½ nickle resistant seal - 50C
09000358	¾ HP through 2 HP silicon carbide seal - 12CS
09000359	3 HP through 7½ HP silicon carbide seal - 50CS
<b>REPLACEMENT IMPELLERS</b>	
<b>Part No.</b>	<b>Description</b>
09001417	¾ HP for 12CS model (stainless steel)
09001471	¾ HP for 11C model (cast iron)
09001418	1 HP for 12CS model (stainless steel)
F92100333	1 HP for 11C model (cast iron)
09001414	2 HP for 12C models (stainless steel)
09004491	2 HP for 12CS models (bronze)
09001419	3 HP for 50CS model (bronze)
09003313	3 HP for 50C model (cast iron)
09001420	5 HP for 50CS model (bronze)
09003314	5 HP for 50C model (cast iron)
09001421	7½ HP for 50CS model (bronze)
09003315	7½ HP for 50C model (cast iron)
<b>PUMP PARTS</b>	
<b>Part No.</b>	<b>Description</b>
F92100319	motor pump adapter, ¾ HP through 2 HP
09001466	volute, ¾ HP through 2 HP
09003316	motor pump adapter, 3 HP through 7½ HP
09003107	volute, 3 HP through 7½ HP

## TW-1 and TW-2 Thermolators

208-230/460V, 9kW & 12kW units, ¾ HP through 7½ HP

## RECOMMENDED SPARE PARTS

PUMPMOTORS	
Part No.	Description
09001403	¾ HP 208/230/460V/3/60 ODP (Open Drip Proof)
09000378	1 HP 208/230/460V/3/60 ODP (Open Drip Proof)
09000381	2 HP 208/230/460V/3/60 ODP (Open Drip Proof)
09000384	3 HP 208/230/460V/3/60 ODP (Open Drip Proof)
09000387	5 HP 208/230/460V/3/60 ODP (Open Drip Proof)
09000390	7 ½ HP 208/230/460V/3/60 ODP (Open Drip Proof)
REPLACEMENT HEATERS	
Part No.	Description
11009001	9 KW 208V/3/60 MS
SET AS PARALLEL DELTA	
11009000	9 KW 230/460V/3/60 MS
09000364	12 KW 208V/3/60 MS
11009001	12 KW 230/460V/3/60 MS
09002814	Heater tube casting
09009957	Heater flange gasket
COOLING SOLENOID OVERHAUL KITS	
Part No.	Description
09004552	¼ inch solenoid overhaul kit, 0.72 CV
09000361	3/8 inch solenoid overhaul kit, 1.5 CV
09004614	½ inch solenoid overhaul kit, 4.0 CV
09004554	¾ inch solenoid overhaul kit, 5.0 CV
COOLING SOLENOID VALVES	
Part No.	Description
09001551	¼ inch solenoid valve, 0.72 CV
09000457	3/8 inch solenoid valve, 1.5 CV
09002969	½ inch solenoid valve, 4.0 CV
09004510V	¾ inch solenoid valve, 5.0 CV
MODULATING VALVES	
Part No.	Description
09002890	½ inch modulating valve, 1.3 CV
09002931	¾ inch modulating valve, 5.0 CV
09003058	1 inch modulating valve, 11.0 CV
09002892	Modulating valve actuator
09002891	Modulating valve linkage
MODULATING VALVE OVERHAUL KITS for #VB7223 VALVE	
Part No.	Description
09004604	½ inch modulating valve rebuild kits, stem and packing
09004605	¾ inch modulating valve rebuild kits, stem and packing
09004606	1 inch modulating valve rebuild kits, stem and packing
MODULATING VALVE OVERHAUL KITS for #VB9223 VALVE	
Part No.	Description
09003227	½ inch modulating valve rebuild kits, stem and packing
09003228	¾ inch modulating valve rebuild kits, stem and packing
09003229	1 inch modulating valve rebuild kits, stem and packing

# RECOMMENDED SPARE PARTS

## TW-1 and TW-2 Thermolators

208-230/460V, 9kW & 12kW units, ¾ HP through 7½ HP

HEATER CONTACTORS	
Part No.	Description
20004401	Heater contactor for 9kW 208/230/460V
20004401	Heater contactor for 12kW 230/460V
09000417	Heater contactor for 12kW 208V
REPLACEMENT BOARDS for TW-1 and TW-2, single- and two-zone	
Part No.	Description
09003732	TW1 operator board for TW-1 single- and two-zone
09003731	TW1 motherboard for TW-1 single- and two-zone
09003735	TW1 flat ribbon cable
09003734	TW2 operator board for TW-2 single- and two-zone
09003733	TW2 motherboard for TW-2 single- and two-zone
09003737	15 feet coiled control cable - TW2
02001186PH	30 feet coiled control cable - TW2
02001187	50 feet coiled control cable - TW2
PUMP OVERLOADS	
Part No.	Description
20003908	Pump overload for: ¾ HP 460V
20003909	Pump overload for: 1 HP 460V
20003910	Pump overload for: ¾ HP 230V and 2 HP 460V
20003911	Pump overload for: ¾ HP 208V and 1 HP 208/230V
20003912	Pump overload for: 3 HP 460V
20003913	Pump overload for: 2 HP 208/230V and 5 HP 460V
20003914	Pump overload for: 3 HP 208/230V and 7½ HP 460V
09000346	Pump overload for: 5 HP 208/230V
09000347	Pump overload for: 7½ HP 208/230V
PUMP STARTERS	
Part No.	Description
20003801	Pump starter for: ¾ HP 208/230/460V
20003801	Pump starter for: 3 HP and 5 HP 460V
20003802	Pump starter for: 3 HP 208/230/460V
20003802	Pump starter for: 7½ HP 460V
20003803	Pump starter for: 5 HP 208/230V
20003804	Pump starter for: 7½ HP 230V
11002015	Pump starter for: 7½ HP 208V
MISCELLANEOUS	
Part No.	Description
11001213	Thermolator transformer
11000400	Thermocouple, standard temp unit, 6 feet
11000050	Water pressure switch
09000823	Process pressure gauge
09000328	Pressure relief valve, 150 PSI
09040000	Caster
09000686	Handle
MANUALS	
Part No.	Description
UGH015/0100	User Guide, Thermolator TW1 and TW-2
QCH012/0200	Quick Card, Thermolator TW-2
QCH013/0200	Quick Card, Thermolator TW-1

